INSTALLATION, MAINTENANCE AND USER MANUAL FOR CARBON DIOXIDE (CO2) FIRE EXTINGUISHING SYSTEM

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1 INTRODUCTION.

This manual is written for those who install, operate and maintain *carbon dioxide (CO_2)* fire extinguishing systems manufactured by ***LPG Тйcnicas en Extinciyn de Incendios S.A.*** It contains system installation, operation and maintenance instructions.

2 MANUAL UTILIZATION.

There are two different useful ways of how to use this manual. Firstly, following the index accurately (mainly when is the first system to be installed and the personnel has no previous experience) and secondly, as a reference book. In both cases, it is necessary the use of the drawings provided with the system as a reference.

In the first case, the manual layout allows the installation of a system chronologically. It is also convenient to refer to the drawings in order to identify the position and number of the components to be installed.

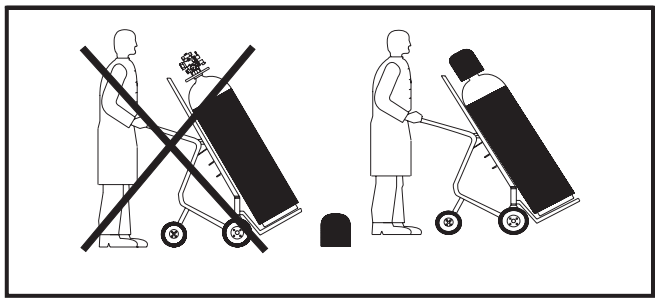
As for the second case, this manual is used when the installer, with previous experience, checks in the first place the drawings provided with the system. Since the denomination and technical data sheet of each part appears in them, each component is easily located in the index and therefore, the appropriate chapter can be consulted.

Intention of this manual is to give specific instructions for installation, maintenance and testing requirements for LPG systems and components. In any case is intended to accomplish any requirements of the applicable and mandatory standards of design and installation of systems.

3 GENERAL.

Carbon dioxide (CO_2) fire extinguishing systems manufactured and designed by LPG are designed as heavy duty equipment, reliable and easy to mount, with simple test routines to check their operating condition as described in this manual. However, ***LPG Tйcnicas en Extinciyn de Incendios S.A***. wishes to clarify the following:

- ☛ All personnel who are assigned to the equipment should be properly trained in its use, inspection, tests and maintenance. LPG recommends at all times the adoption of safe working practice in accordance with current health legislation and safety procedure. It is recommended that personnel in charge of installation and maintenance of the fire extinguishing system should be properly trained in its safe use and should read the whole of this manual before initiating any of the operations mentioned above.
- ☛ All personnel working in an enclosure protected by *carbon dioxide (CO_2)* systems should be warned of the effects on personnel and protected properties. Personnel in the protected area should be trained in the modes of actuation in case of alarm and in the different types of system activation.
- ☛ During installation and maintenance operations personnel should be protected by wearing protective clothing and shoes and when necessary helmet and gloves. Safety glasses or facemask should be worn whenever holes are drilled for pipe supports or cylinder bank brackets. Such protection is also needed when dealing with particle emission.
- ☛ Due to possible false alarm of the detection system (if installed) produced by dust or smoke caused by installation works, the detection system in the area should be isolated or disconnected prior to staring and during the assembly operations.
- ☛ All the equipment and pipe system should be installed in accordance with the project drawings. Systems are made up of units tested within limitations. The system designer must be consulted whenever changes are planned for the system or area of protection. Constructive drawings should be corrected and modifications included in the project.
- ☛ An authorized installer or system designer must be consulted after the system has discharged.
- ☛ ***Protective cap must always be installed on the discharge valve when a cylinder is being transported to its final destination*.**



- ☛ Use one or several of the following as thread joint compounds.

  - 0’4 mm thread joint compound.
  - Teflon tape.

Whichever sealing compound is used, never cover the two first threads to ensure internal cleanliness of the pipe system.

4 DESCRIPTION OF CARBON DIOXIDE (CO_2) SYSTEMS.

Centralised *carbon dioxide (CO_2)* fire extinguishing systems manufactured and designed by LPG are developed as reliable equipment and easy to mount.

LPG centralised systems consist of 4 elements:

Storage Systems.

Comprising steel cylinders containing the extinguishing agent.

Release System.

Controls the activation and later discharges the gas contained in the cylinders. Consists of a pilot valve, which integrates the different release devices, such as manual release, solenoid valve electrical release and pneumatic release, which control opening of cylinder valves or slave cylinders. It is a flexible system that allows the installation of more than one pilot valve. This system can actuate simultaneous batteries depending the necessity.

Distribution System.

Directs gas discharge from the cylinders to the protected zone.

Support System.

Consisting of a metallic structure (brackets), which supports the cylinder block. According to the configuration there are single row and double row models.

All personnel who are assigned to this equipment in commissioning, inspection, tests and maintenance operations should be thoroughly trained in the functions they perform.

The number of *carbon dioxide (CO_2)* cylinders required to protect the hazard area is determined by specific calculation for each application.

All systems may be actuated automatically by means of the solenoid valve or manually. Manual actuation systems incorporate devices to prevent accidental discharges.

Personnel in the protected area should be instructed in the modes of actuation in case of alarm and in system manual actuation.

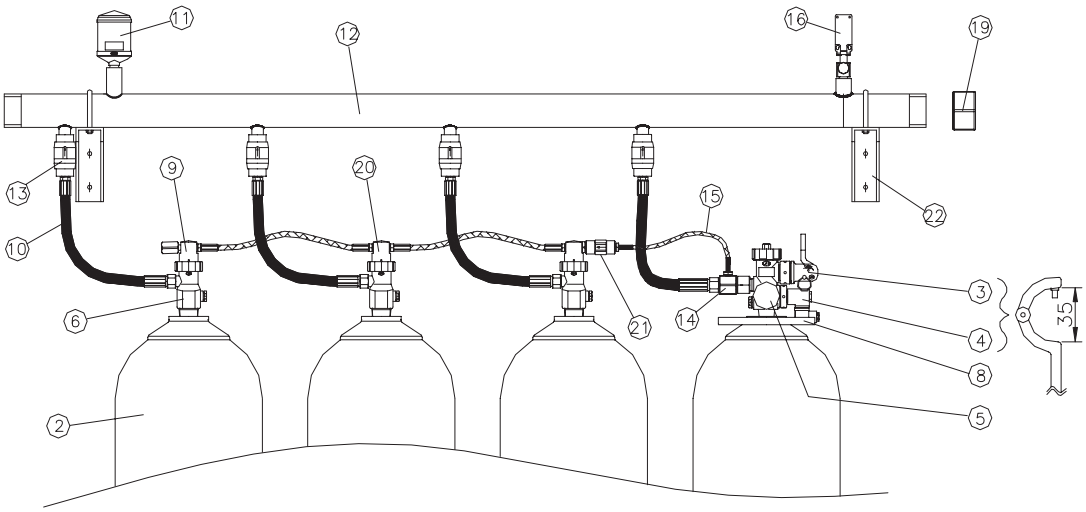
4.1 SYSTEM 1: CYLINDER BANK OF 8 OR LESS CYLINDERS OF 40’2, 67, 100 LITRES.

A master cylinder is one of the bank of cylinders and is filled with the same contents as an slave cylinder. In this system pressure released at the opening of the master cylinder is directed towards the pneumatic release heads of the slave cylinders used to discharge all the valves together. LPG 128-20 and LPG 128-30 valves are used on master cylinders. LPG 110-00 and LPG 110-10 are used for slave cylinders.

The pneumatic release system incorporates a non-return valve to maintain the optimal pressure level for the activation of all the cylinders and a device to safely vent of residual pressure in release pneumatic circuit.

The control panel via a solenoid valve may actuate the system automatically. For manual actuation it is necessary to access the Master cylinder release, remove the safety seal and pull the lever.

EXAMPLE LAY-OUT



Pos	Description	Pos	Description
1	Master cylinder (LPG 128-20)	11	Odorizer
2	Slave cylinder (LPG 110-00/LPG 110-10)	12	Discharge manifold (up to 4”)
3	Manual pneumatic release	13	Check valve
4	Solenoid valve	14	Deviator device
5	LPG-128 Valve	15	PTFE release hose 1/4” x 350
6	LPG 110 valve	16	Pressure switch with locking device
8	LPG 128 cylinder flange	19	Blind cap threaded NPT
9	Decompression screw	21	1/4" non-return valve
10	R2 Discharge hose	22	Manifold seat

4.2 SYSTEM 2: CYLINDER BANK UP TO CYLINDERS OF 40'2, 67, 100 LITRES.

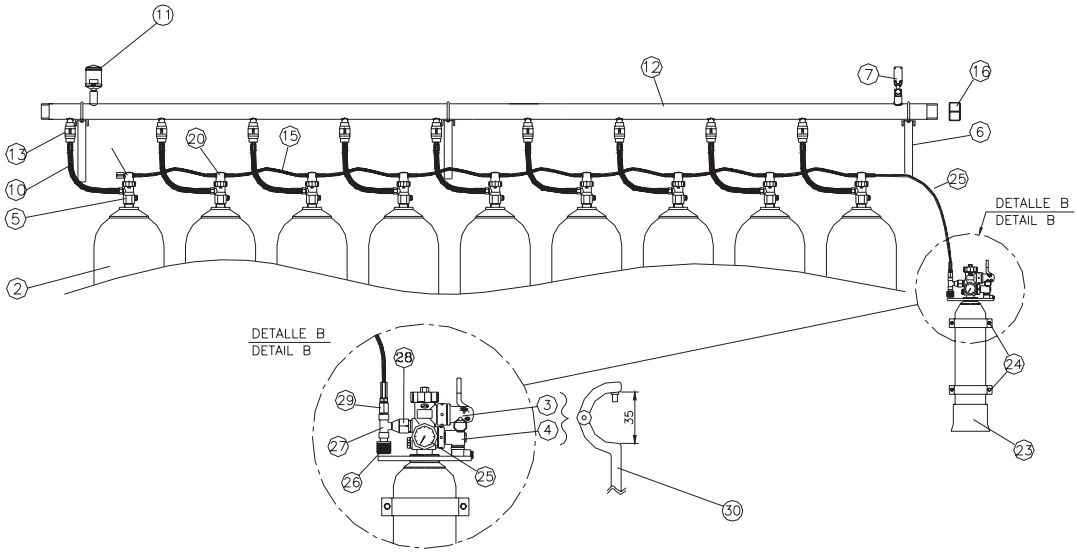
A pilot cylinder of reduced volume filled with dry nitrogen at 100 bar is used. In this case the pilot cylinder contents are not used as effective extinguishing agent. The pressure released at the opening of the pilot cylinder is directed towards the pneumatic release heads of the slave cylinders. Valves used on the pilot cylinder is or LPG 128-90. Slave cylinders are fitted with LPG 110-00 and LPG 110-10 valves.

The cylinder bank is delivered fitted with devices to prevent actuation through micro-leakage a well as controlled release evacuation of residual pressure in the pneumatic release circuit.

The control panel via a solenoid valve may actuate the system automatically. For manual actuation it is necessary to access the pilot cylinder manual lever release, remove the safety seal and pull the lever.

After a real system activation it is necessary to release residual pressure trapped within the pneumatic release circuit.

EXAMPLE LAY-OUT



Pos	Description	Pos	Description	Pos	Description
2	Slave cylinder	11	Odorizer	24	Rack with straps pilot cylinder
3	Manual actuator	12	Manifold pipe	25	Pressure gauge
4	Solenoid Valve	13	Check valve	26	Depressurization valve 1/4"
5	LPG 110 valve	15	PTFE release hose 1/4"x350mm	27	"T" 1/4" male to 2x1/4" female
6	Manifold seat	16	Blind cap threaded NPT	28	Reduction 21'7 to 1/4" H-H
7	Pressure switch with locking device	20	2 ways pneumatic head	29	Coupling 1/4" to hose
10	R2 discharge hose	23	N2 pilot cylinder (LPG 128-90)	30	Rounded spanner

4.3 SYSTEM 3: CYLINDER BANKS FITTED WITH SELECTOR VALVES.

Selector valves may be adjusted to any system described above.

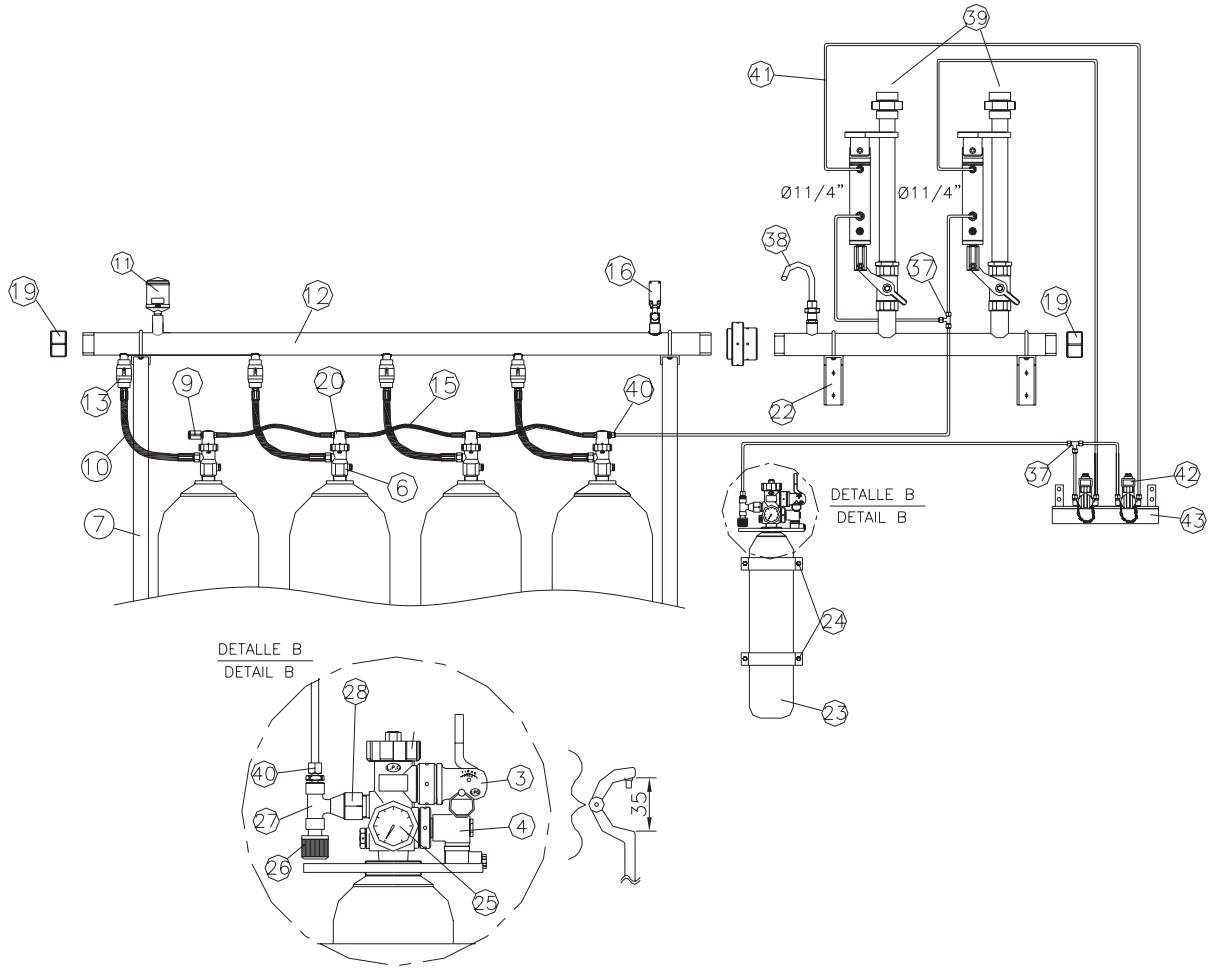
These cylinder banks consist of a manifold discharge pipe which incorporates a length specially designed and fitted with the required couplings for the selector valves. The selector valve pneumatic supply system is made of 4 x 6 mm diameter copper pipe. In accordance with the design requirements primary and reserve storage systems with selector valves may be used. The exact number of cylinders to be discharged in each hazard area may be determined also.

A selector valve system always consists of a pilot cylinder filled with dry nitrogen at 100 bar. Actuation may be automatic via the control panel and solenoid valve or manually. In the event of automatic actuation, the pilot cylinder solenoid valve and solenoid valves + selector valve manual release actuation are activated at the same time.

In the event of manual actuation it is necessary to have access to the solenoid valve + selector valve manual release protecting the hazard zone, remove the safety seal and pull the fitted lever. Later remove safety seal on pilot cylinder manual release lever and pull the lever.

The valves as well as the pneumatic actuation system are identical to those described in System 2.

EXAMPLE LAY-OUT



Pos	Description	Pos	Description	Pos	Description
3	Manual release	15	PTFE release hose 1/4"x350mm	27	"T" 1/4" male to 2x1/4" female
4	Solenoid valve	16	Pressure switch with locking device	28	Reduction 21'7 to 1/4" H-H
6	LPG 110 valve	19	Blind cap threaded NPT	37	"T" coupling Cu6 pipe
7	Bracket	20	2 ways pneumatic head	38	Manifold safety disk
9	Decompression screw	22	Manifold seat	39	Selector valve
10	R2 discharge hose	23	N2 pilot cylinder (LPG 128-90)	40	Coupling 1/4" to Cu Tube 4x6
11	Odorizer	24	Rack with straps pilot cylinder	41	Cu Tube 4x6
12	Manifold pipe	25	Pressure gauge	42	Selector valve solenoid W/ Manual level
13	Check valve	26	Depressurization valve 1/4"	43	Selector solenoid bracket

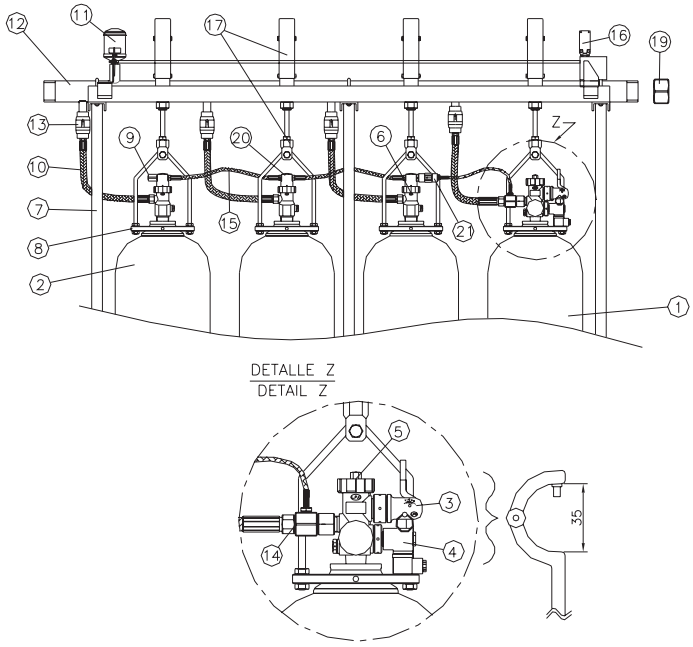
4.4 SYSTEM 4: CYLINDER BANKS PROVIDED WITH WEIGHING SYSTEMS.

A weighing system may be fitted to any of the systems described above This system can be mechanical or electronic by cell.

Due to the vapour pressure of *carbon dioxide (CO_2)* (57'2 bar at 20 C°, 0'67 and 0'75 kg/l fill density according with NFPA 12:2000; CEA 4007:1997-08 and CEPREVEN R.T.4. CO2 1998) it is not necessary to super pressurise cylinders with dry nitrogen to obtain full cylinder discharge. Therefore, the cylinder internal pressure does not depend on the quantity of gas contained. In this way it is not possible to detect leakage just by viewing the valve gauge. To control the level of *carbon dioxide (CO_2)* content in the cylinder bank, LPG has electronic and mechanical weighing device systems available to continuously control the weight of each of the cylinders. In case of leakage or discharge of cylinders, the weighing device system emits an alarm signal.

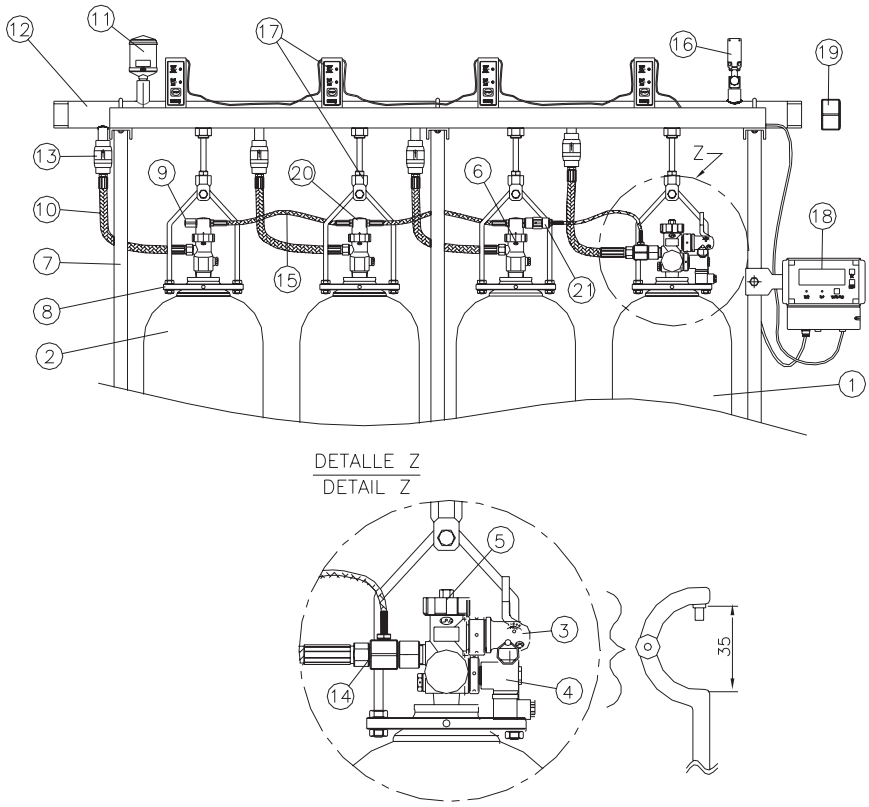
Both weighing device system allows alarm monitoring via external systems (control panel or main control).

The use of a weighing device system does not require valve modification or modification of actuation modes described above.



Pos	Description	Pos	Description	Pos	Description
1	Master cylinder (LPG128)	8	Lifting flange	15	PTFE release hose G 1/4" x 700 mm
2	Slave cylinder (LPG 110)	9	Decompression screw	16	Pressure switch with locking device
3	Manual release	10	PTFE release hose1/2"	17	Mechanical weighing module
4	Solenoid valve	11	Odorizer	19	Blind cap threaded NPT
5	LPG 128-20(30) valve	12	Manifold pipe	20	Pneumatic release head 2 ways
6	LPG 110-00 valve	13	Check valve	21	1/4 " non return valve
7	Bracket	14	Deviator device		

EXAMPLE LAY-OUT



Pos	Description	Pos	Description	Pos	Description
1	Master cylinder (LPG128)	8	Lifting flange	15	PTFE release hose G 1/4” x 700 mm
2	Slave cylinder (LPG 110)	9	Decompression screw	16	Pressure switch with locking device
3	Manual release	10	PTFE release hose 1/2”	17	Cell weighing modul
4	Solenoid valve	11	Odorizer	18	Cell weighing system control panel
5	LPG 128-20 valve	12	Manifold pipe	19	Blind cap threaded NPT
6	LPG 110-00 valve	13	Check valve	20	Pneumatic release head 2 ways
7	Bracket	14	Deviator device	21	1/4" non return valve

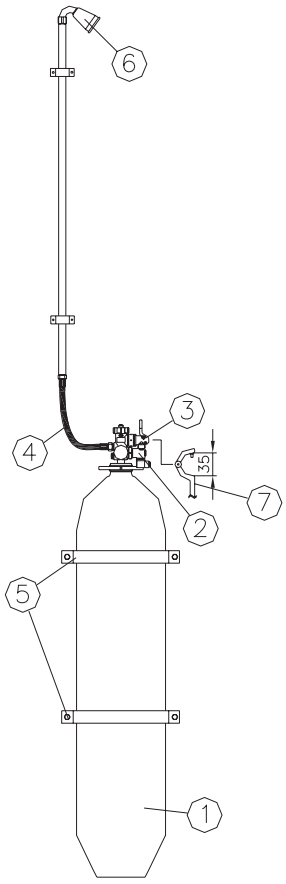
4.5 SYSTEM 5: SELF-CONTAINED CYLINDER.

In this case, the system consists of only one cylinder, which contains the extinguishing agent, and the valve incorporates all actuation and discharge release systems. The valve makes use of the pressure contained in the cylinder to open. Normally fitted with manual and electrical solenoid valve actuation system. Pneumatic actuation is also possible for special applications.

There are self-contained cylinder models of 5, 13’4, 26’8, 40’2, 67 and 100 litres fitted with LPG 128-20 and LPG 128-30 valves. The valve incorporate micro leakage proof actuation devicesand a safety disk to prevent cylinder over pressurisation.

A control panel via solenoid valve may activate self-contained cylinders automatically. For manual actuation it is necessary to access the manual release lever, remove the safety seal and pull the lever.

EXAMPLE LAY-OUT



Pos	Description
1	Self-contained cylinder (LPG128-20, LPG128-30)
2	Solenoid valve
3	Manual release
4	Discharge hose R2
5	Bracket
6	Nozzle
7	Rounded Spanner

5 INSTALLATION.

During system Installation it is recommended to make continual use of drawings enclosed with component delivery. This will help to understand the system better.

As an example Annex I consists of standard drawings showing different models of *carbon dioxide (CO_2)* cylinder banks. In these the arrangement of cylinder bank, connection of single release system and arrangement of standard support systems can be seen. These drawings are enclosed as an example, however for installations accompanied by specific drawings, these will prevail.

Prior to starting installation check the drawings and lists of materials to ensure that all components have been delivered. Check that the components are not damaged. Any defective components should be replaced. Check the position of the cylinders and lengths of pipes in the drawings. Check that there are no fixed barriers, which may require modification of cylinder location, brackets and lengths of pipes. The Project Engineering Department should be informed of any deviation from the drawings.

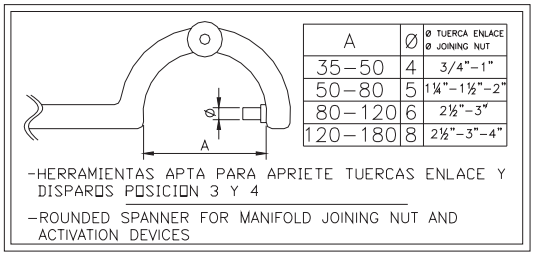
Prior to starting installation check the cylinder bank location (generally indicated in the drawings). The location advisable for the cylinder bank would be a room as near as possible but outside of hazard protected, big enough to house the equipment and to facilitate Installation and maintenance operations. The equipment should not be exposed to severe weather conditions, direct contact with flame, excessive humidity and safe from unauthorised handling and mechanical or chemical damage.

Required material for equipment installation:

- Teflon tape, 0'4 mm thread sealing compound
- White Vaseline
- Set of fixed wrenches (6 to 22 mm)
- Monkey wrench
- Clamps, pliers
- Set of Allen keys
- Set of Phillips and flat head screwdrivers
- Electric hand hammer / drill
- M.12 Plugs of quality suitable for the fixing surface.
- Drills (for building materials)
- Hacksaw
- Pipe cutter suitable for cutting copper pipes
- Ladders, scaffolds
- Flexometer
- Magnetic level
- Electric Tester
- Rounded Spanners (See note)

Note: A minimum of two operators is required to perform equipment installation.

Rounded Spanner.



5.1 MECHANICAL / PNEUMATIC INSTALLATION.

LPG *carbon dioxide (CO_2)* centralised systems are divided into 4 systems:

1. Support system.
2. Storage system.
3. Release system.
4. Distribution system.

Installation operations and components for each system are described as follows. The sequence in which components are described is at the same time, the order in which they should be installed.

5.1.1 Support system.

Description:

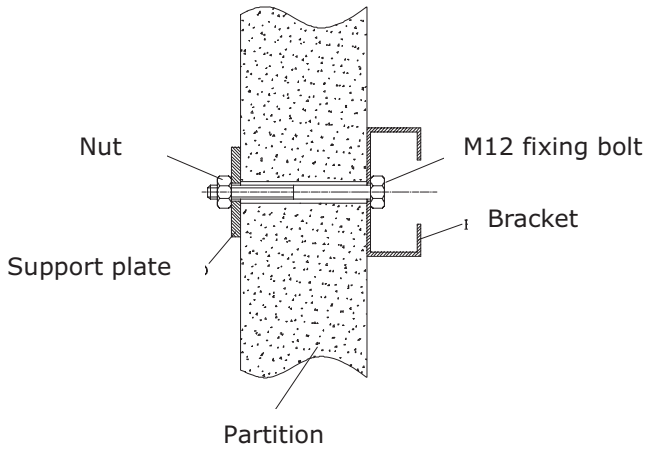
A metallic structure consisting of a frame (bracket) which supports the cylinder block and the manifold.

The brackets are just fixed to the wall (no support columns) or are provided with vertical support columns. There is also an specific model for the systems with the weighing device.

Installation:

The following points should be considered at the time of performing the installation:

- Thoroughly clean the area where the system is going to be located. Check the drawing measurements to ensure that the cylinder bank fits perfectly in location chosen.
- Verify that the floor where the system is going to be mounted is as flat as possible.
- The wall where the bracket is going to be fixed (if necessary) must be solid and in perpendicular position from the floor (avoid partition walls, Pladur or similar).
- If the bracket has to be fixed to a partition wall, plates to support the bracket on the opposite face of the partition wall should be used in accordance with drawing:



The Installation of the bracket and the position of manifold depend on whether the bracket is fitted with vertical side support column or not and whether connection to pipe system is vertical or to the side.

5.1.2 Installation of brackets.

LPG supplies the cylinder fixing brackets together with equipment. Among them, three types may be distinguished:

a) Brackets provided with vertical support column.

b) Brackets with no vertical support column.

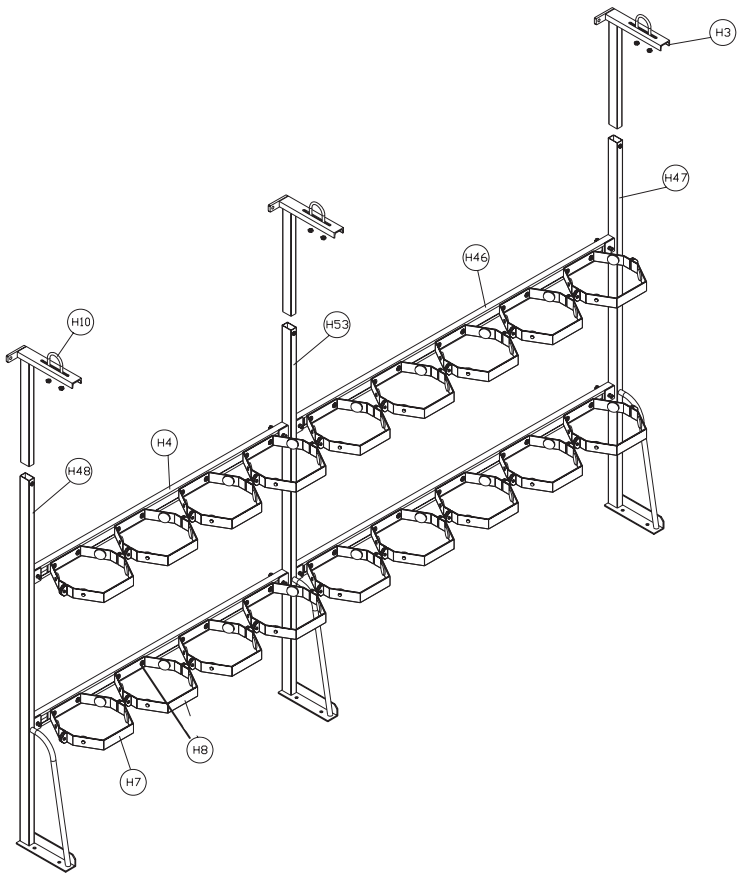
c) Brackets for self-contained cylinders.

Within each of these types there are different models, which comply with use requirements of system supplied. This manual describes the characteristics of each of the types but without entering into Installation details for each of the models consisting of these. To perform installation "in situ" drawings supplied together with equipment should be used and instructions contained in this manual should be taken into account.

Attention:	***Always complete the final installation of brackets, cylinders and manifold pipe prior to performing connection between the manifold pipe and the nozzle system. This method prevents many adjustment problems during installation of different cylinder bank components.***

As an example, Annex I contains standard drawings showing brackets described above.

5.1.2.1 Installation of brackets with vertical support columns.



Pos	Description
H3	Manifold seat
H4	Rear crosspiece 4 cylinders
H7	Hexagonal cylinder support
H8	Rubber protection
H10	Manifold "U" fixation
H46	Rear crosspiece 5 cylinders
H47	Right side column
H48	Left side column
H53	Centre column

Fig. 5.1.2.1. *Example of single row bracket with vertical support column*

The characteristic of this type of bracket is that the vertical support columns are included which may be fixed directly to wall and floor. This configuration gives stability and rigidity to the cylinder bank assembly.

The following models are included within this family:

a) **Single row bracket:** All bank cylinders are aligned in a single row and the weight of the manifold pipe rests on the bracket structure.

b) **Double row bracket:** All bank cylinders are aligned in two parallel rows and the weight of the manifold pipe rests on the bracket structure.

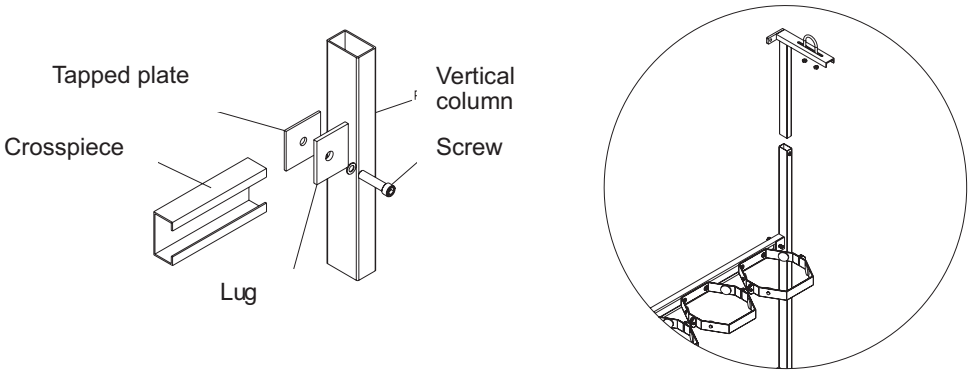
c) **Bracket with weighing device:** The cylinders can be aligned in a single row or in two parallel rows. The cylinders are supported on the bracket structure.

Enlarged drawings of different models of brackets are enclosed in Annex I. Refer to them for identification of each element described in the written procedure.

Attention:	***Never begin to mount bracket by connecting manifold pipe to the nozzle pipe system. Such method gives rise to many adjustment problems during the installation of the remainder of the cylinder bank components.***

The following points should be considered when faced with the job of Installation one of these brackets:

1. A drawing of the mounted system is delivered with every equipment supplied and at least a standard enlarged drawing with the bracket. It is essential to understand these drawings thoroughly prior to start Installation.
2. Drawings supplied indicate cylinder bank measurements. Perform an initial check to ensure that the structure fits perfectly in the area chosen.
3. Clean the area where the bracket is going to be installed.
4. In accordance with system drawings perform a bracket pre-Installation on the floor. It is not necessary to mount the complete bracket. It is sufficient to mount those structure components closest to the wall.
5. When performing pre-Installation it is necessary to take into account the fixing system of the different structure parts. Vertical support columns incorporate some welded or screwed lugs on their sides. The purpose of these lugs is to hold the cylinder bank crosspieces[1]. Correct connection between the vertical support column and the crosspiece is described in the following figure.



6. The manifold seats[2] are mounted directly onto the vertical support columns. Depending on the cylinder bank model, manifold seats may differ according to their position on the cylinder bank. It is essential to consult the system drawing to determine the exact position of each.

Attention:	***In order to avoid an accident during the installation of the system, screw slightly the block screw that are incorporated in the vertical support column.***

7. Once pre-Installation is performed, put them in their final position taking into consideration the required distance for connection between the manifold pipe and the nozzle pipe system. When accurate location is found, tighten all screws, which ensure the connections between support vertical columns and the crosspieces to make the structure rigid. Align the different structure components vertically and horizontally so as not to distort the shape or position of bracket.

8. Place the two bank cylinders which are farthest apart from each other onto brackets and tighten. For cylinder banks consisting of 8 or less cylinders, one of them may be the pilot cylinder. Align the valve outlet as indicated in system drawing.

9. Locate the manifold pipe[3] onto its seats and make level fitting the height of each one of them. W**arning: the system is not fastened onto any fixed part in the building yet.** Take the necessary precautions to prevent the assembly from falling over.

10. Place the manifold check valves for each of the cylinders presented. It is not necessary to perform final installation of these parts.

11. Place discharge hoses between cylinder valves and the check valves. It is not necessary to perform final installation of hoses.

12. Find the best location for the manifold with respect to the location and position of the discharge hose. Compare with the cylinder bank drawings. Once proper location of manifold is found, that is final position of bracket. Independently of the representation of the draws, it is possible that for a perfect adjustment all the cylinders must be turned a little on themselves by rows. All of them must be turned in the same sense.

13. Check the vertical and horizontal level of the cylinders and mounted parts of the brackets prior to marking anchoring points on the floor and wall. It is possible to drill taking as a guide those fixing holes on the brackets. Fix bracket into its final position. High-power chemical or mechanical fixing plugs should be used for floor and wall fixing. Do not use plastic plugs.

14. Mount the remainder of bank cylinders onto the bracket and finish the metallic structure. It is very important that all cylinders are in the same direction and vertically levelled so as to prevent problems when installing discharge hoses.

15. Fix the block screws. If it is considered advisable, once the system is mounted, drill the vertical column and the seat and place a screw.

16. When all the cylinders are mounted with their hoses and check valves and all assembly is fixed and secured, then it is possible to connect the manifold pipe to the nozzle system.

17. Carry out the installation of the remainder cylinder bank parts in accordance with the instructions described in this manual.

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1 Crosspiece: Metallic piece, which is, mounted horizontally joining two vertical support columns.

2 Manifold seat: Metallic piece which supports the manifold pipe weight. It has a square shape and is always mounted on vertical support columns.

3 Manifold pipe: Length of pipe, which collects all the gas, discharged from the cylinder bank and directs this to the nozzle system.

5.1.2.2 Installation of brackets for self-contained cylinders.

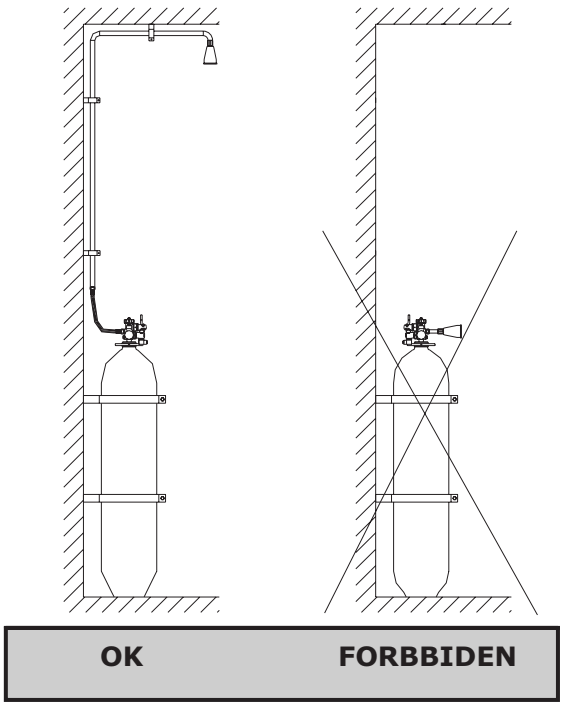
These brackets are designed for holding one single cylinder. Installation is very simple. Just place the bracket against the wall to the height indicated in the drawings supplied. Fix the cylinder taking care that the pressure gauge and manual actuation system are easily visible and accessible. Once the cylinder is installed connect to the nozzle line together with the discharge hose supplied.

Annex I includes different Installation systems depending on the self-contained cylinder volume. Refer to them to identify each one of the elements described in procedure.

High power chemical or metallic fixing plugs should be used for fixing bracket onto the wall. Do not use plastic plugs. If the wall is not strong enough carry out Installation as described in 5.1.1.

It is very important never to install nozzles directly at cylinder outlet for two reasons. Firstly, if nozzle is installed directly on valve outlet there are many possibilities that the nozzle will be at a person's height. In case of cylinder discharge (accidental or otherwise) pressure released could cause serious injuries to personnel who might be somewhere near the cylinder.

Secondly, the strength of reaction produced by the discharge is always generated at the gas outlet. If coupled to the cylinder outlet, the result could be that the wall bracket could be violently pulled out.

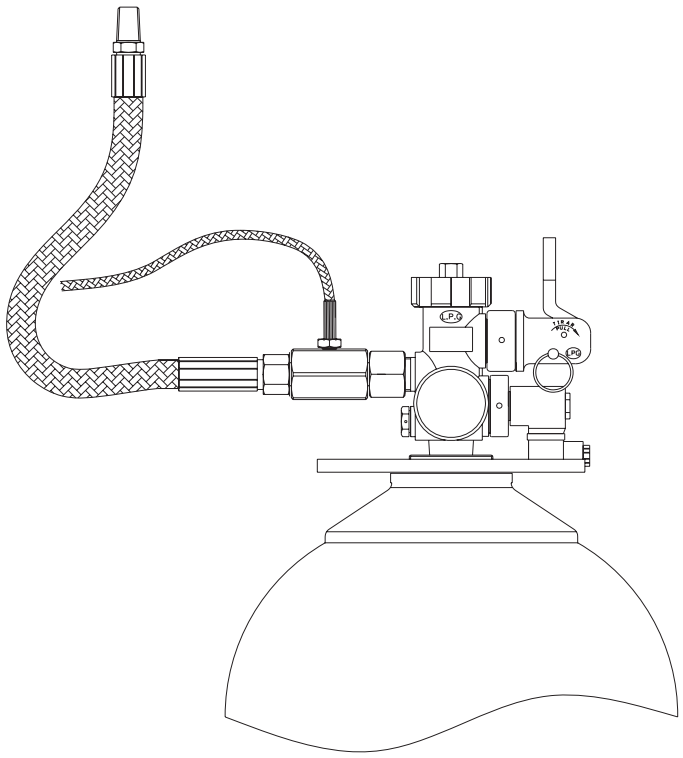


5.2 STORAGE SYSTEM.

Consists of an assembly of steel cylinders containing extinguishing agent, discharge valves and the discharge manifold. Also available cylinder banks equipped with 2 rows of cylinders. The assembly is complemented with several control and slave components.

The components, which make up a *carbon dioxide* (CO_2) storage system, are described below. The sequence to follow for Installation is the same as the order described below.

5.2.1 Carbon dioxide (CO_2) *LPG valve: LPG 128-20 and LPG 128-30.*



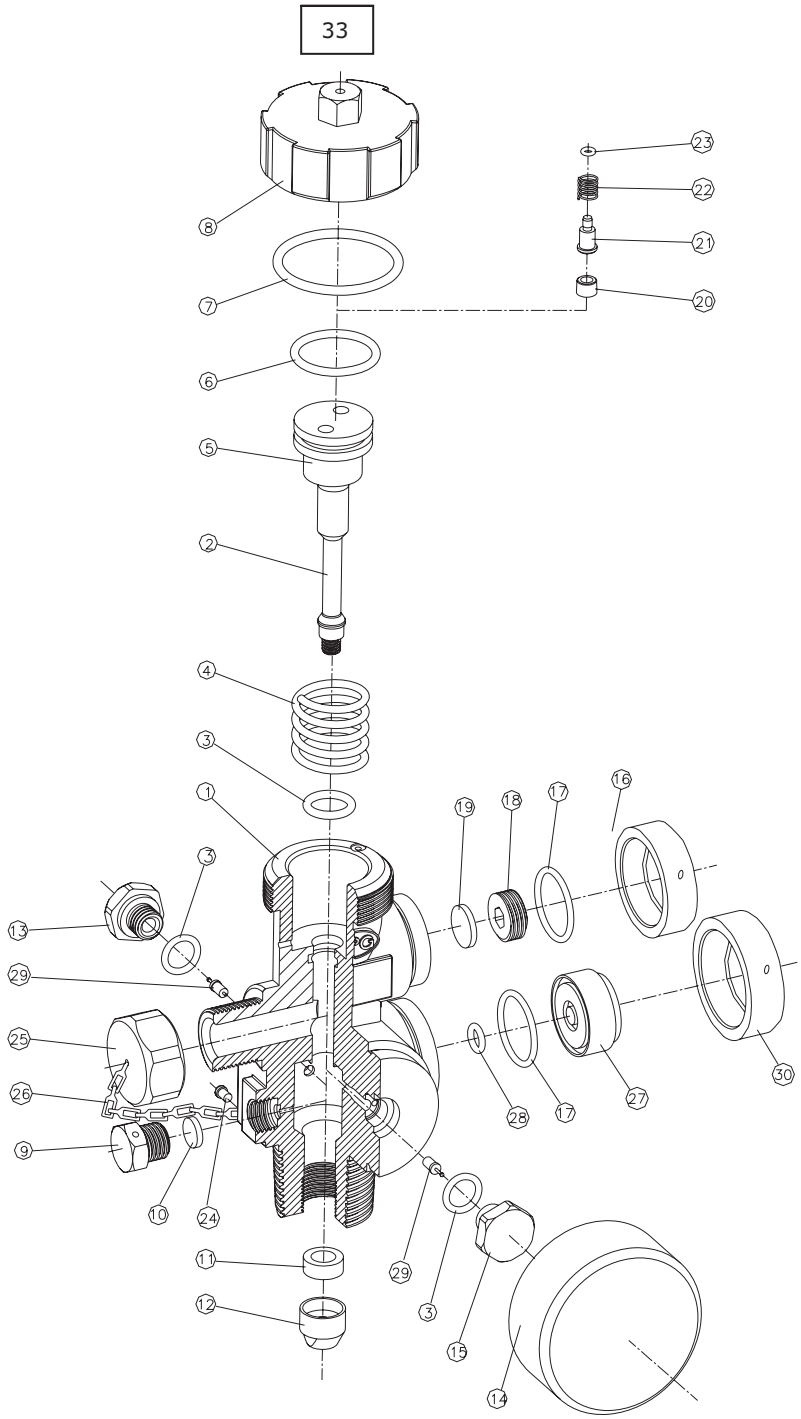
LPG 128-20 Valve

Description:

Valve model **LPG 128-20 and LPG 128-30** are used with master or self-contained cylinders of 5, 13'4, 26'8,40'2, 67 and 100 litres capacity.

For further information about valves, refer to figure 5.2.1.1. which shows an enlargement of valve model LPG 128-20(30).

It is a differential opening valve. Actuation may be achieved by manual release, pneumatic release or electric release. Allows for coupling of a pressure gauge and a pressure switch instead of the plugs (13, 14 and 15) (are not supplied as a standard by LPG). A safety disk is incorporated against over pressurization set at 190 bar (10).



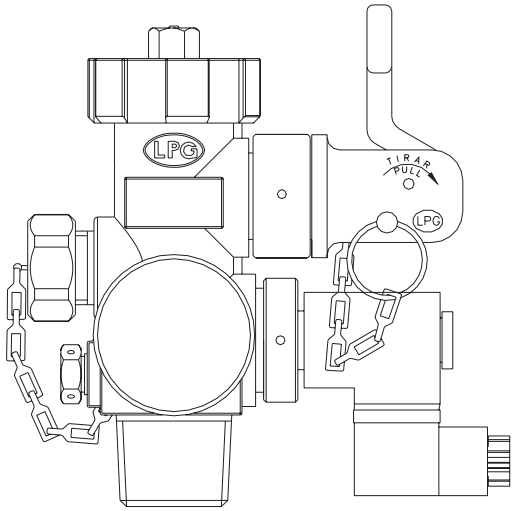
Pos	Description
1	Valve body
2	Valve axle
3	O-ring
4	Recovery spring
5	Valve piston
6	Piston sealing O-ring
7	Head cap sealing O-ring
8	Head cap
9	Safety disk cap
10	Safety disk
11	Valve sealing joint
12	Joint holder
13	Pressure switch housing cap
14	Blind cover
15	Gauge blind cap
16	Burst disk blind tap
17	Blind tap, burst disk and solenoid valve sealing O-ring
18	Burst disk fixing
19	Burst disk
20	Relief valve fixing
21	Relief valve piston
22	Relief recovery spring
23	Relief valve sealing O-ring
24	Outlet cap chain fixing screw
25	Flow outlet cap
26	Outlet cap chain
27	Valve blind cap
28	Solenoid
29	Schrader valve cap
30	Solenoid valve fixing nut
33	Head cap orifice

Fig. 5.2.1.1. *LPG 128-20(30) "explosion" valve*

The relief valve device on the head cap (made up of parts 20, 21, 22, 23) prevents accidental cylinder discharge caused by micro leakage of pressure produced by some release devices.

The safety disk (10) is set ready to burst and release the internal cylinder pressure when the pressure reaches values slightly inferior to the cylinder hydraulic pressure. This device prevents an excessive rise in pressure (for example, due to over heating) that may cause the assembly to explode.

The burst disk (19) allows actuation of manual and pneumatic release devices. When this disk bursts by means of the release system connected to it, the valve opens. Its set pressure does not allow bursting caused by cylinder over pressure.



To prevent uncontrolled accidental discharges during installation, maintenance operations or handling of the valve, remove the head cap (8) and place the cap (25) on the valve outlet. This simple operation prevents risks; in case of accidental release the orifice (33) will direct gas from the cylinder to the atmosphere in a controlled way, thus preventing valve actuation. The safety disk cap (9) incorporates orifices, which allow controlled gas discharge in case over pressurisation bursts the safety disk (10).

Installation:

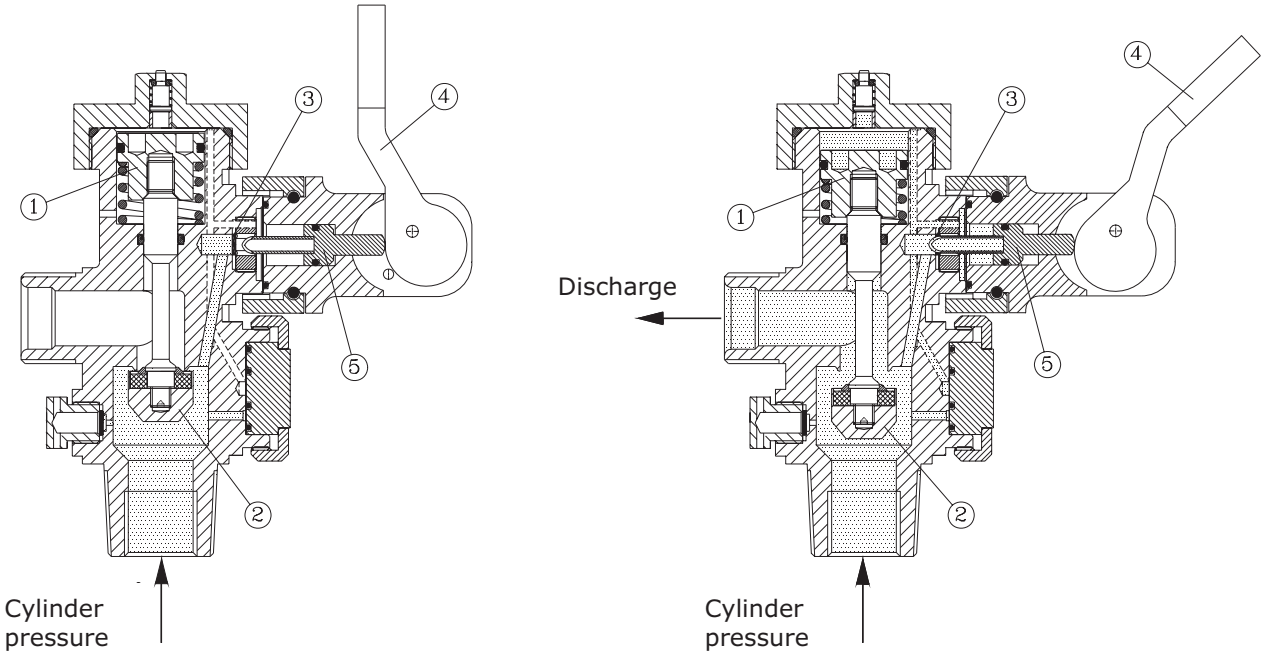
The valve is supplied mounted onto the cylinder. Do not try to disassemble any of the accessories that come incorporated. The Installation parts attached to the valve (discharge hose and release devices) should be performed later, following the order they are described.

Note:	***Always consult the instructions contained in this manual prior to Installation or disassembling any valve part. this equipment is pressurised. negligence or bad handling could cause uncontrolled discharge, injuries to personnel and damage to property. in case of doubt, always consult LPG technical department.***

Note:	***For any installation or maintenance operation, the valve head cap (8) must remain dismantled as a safety measure. when any Installation, maintenance or test operation is finished, do not forget to replace the head cap. hand tighten, check that head cap sealing "o" ring (7) is mounted in its interior.***

Manual Lever Release Actuation

This actuation system is used for pilot cylinders and self-contained cylinders.



LPG Valves make use of the cylinder internal pressure for opening.

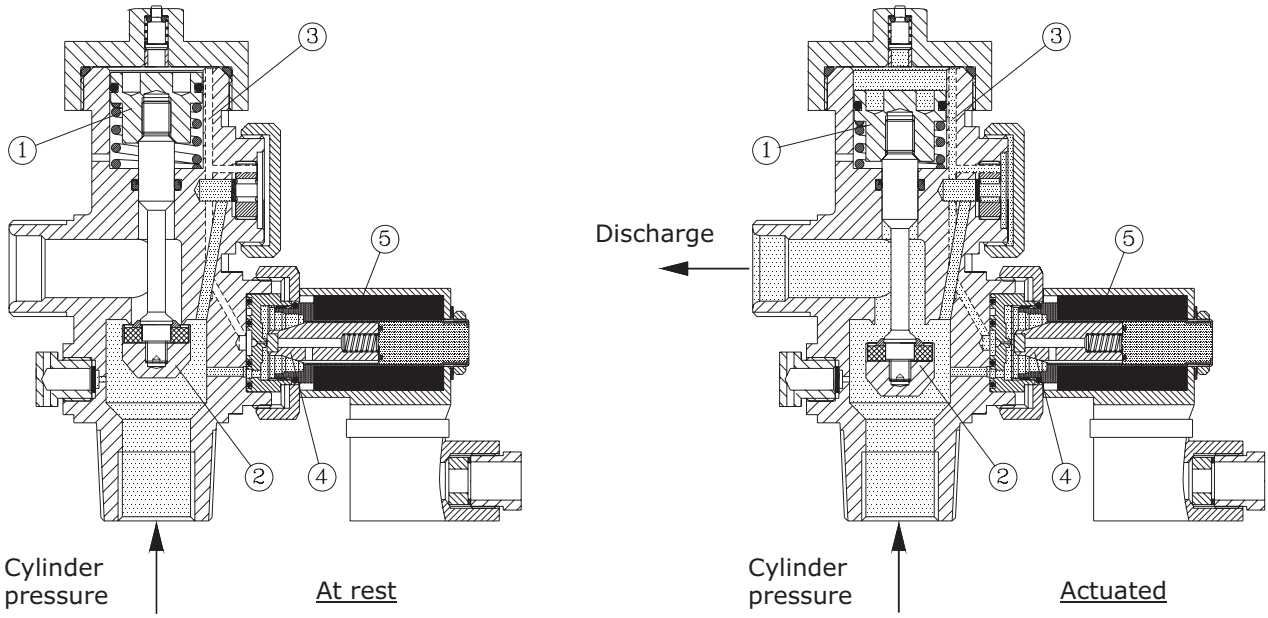
The only way to activate valve is by making the piston move downwards (1).

When valve is at rest, pressure is retained by the sealing element (2) and the release disk (3).

When the release is activated manually by pulling the lever (4) backwards and the hammer piston (5) is pushed downwards, this will cause the release disk (3) to burst. At that moment the pressure retained by the release disk is released and directed over the piston (1). Given that the ratio of surface area between the piston (1) and the sealing element (2) is 3:1, the piston moves downwards and opens the valve.

Actuation by Solenoid Valve

This actuation system is used for self-contained cylinders.



LPG Valves make use of cylinder internal pressure for opening.

The only way to activate valve is by making the piston move downwards (1).

When valve is at rest, pressure is retained by the sealing element (2) and the piston (4) in the solenoid valve (5).

When solenoid valve (5) is energised, the piston (4) moves backwards allowing free passage of pressure. This pressure is directed through the internal passage (3) over the piston (1). Given that the ratio of surface area between the piston (1) and the sealing element (2) is 3:1, the piston moves downwards and opens the valve.

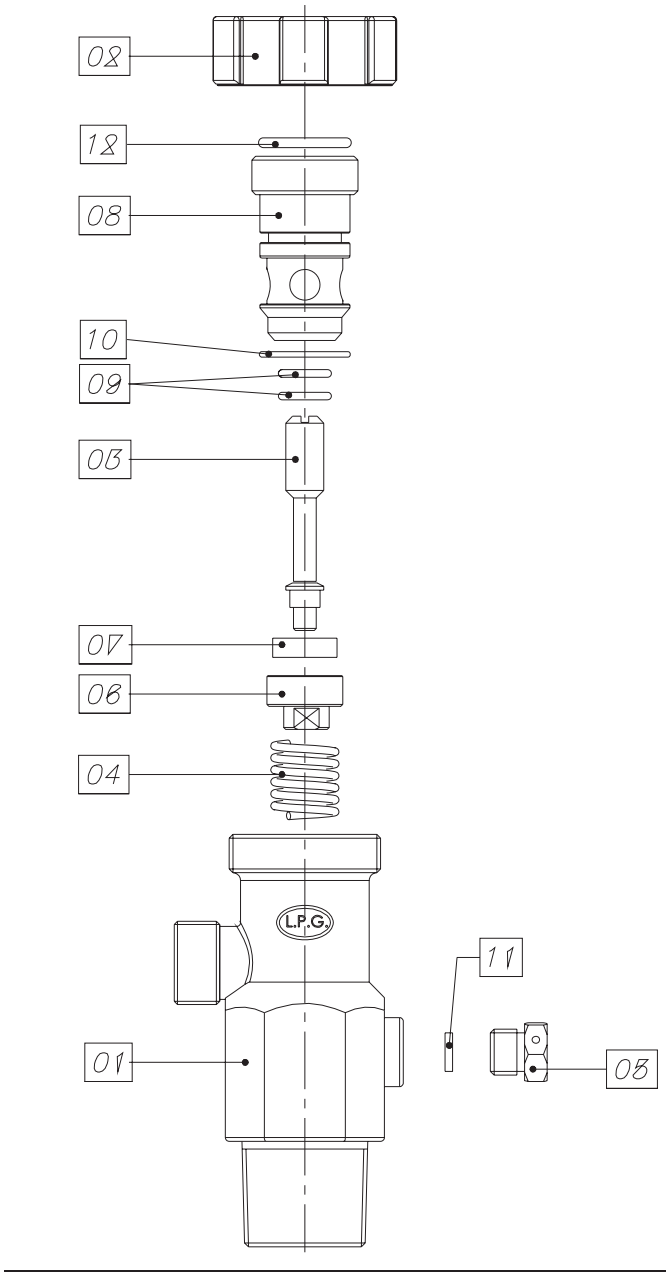
5.2.2 Carbon dioxide (CO_2) *LPG valve: LPG 110-00.*

Description:

The LPG 110 valve is used in auxiliary cylinders of centralised systems or modular cylinders of the following capacities: 5, 13'4, 26'8, 40 and 67 litres with manual activation

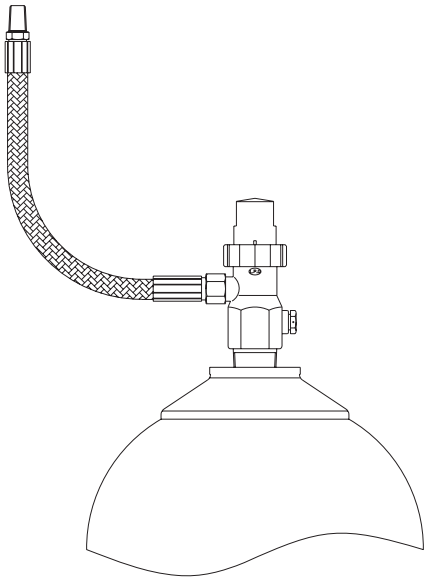
In order to have more information about the LPG 110 valve components, please refer to fig. 5.2.2.1. In that illustration, there is a drawing showing the inner details of the valve.

The design of the valve is very simple and is focussed on its use as valve for auxiliary cylinders in Co2 systems. It can be released pneumatically and/or manually. As safety devices, you can find a safety disk against overpressures set at 190 bar.



Pos	Description
1	Valve body
2	Head cap
3	Axle
4	Recovery spring
5	Safety disk cap
6	Joint holder
7	Valve sealing joint
8	Inner cartdrige
9	Axle sealing O-ring
10	Inner cartdrige lower O-ring
11	Safety disk
12	Inner cartdrige higher O-ring

Fig. 5.2.2.1. *LPG 110-00 "explosion" valve*



When the cylinder is used as auxiliary cylinder, there is a pneumatic head of 2 or 3 ways with pneumatic connection as shown in the drawing.

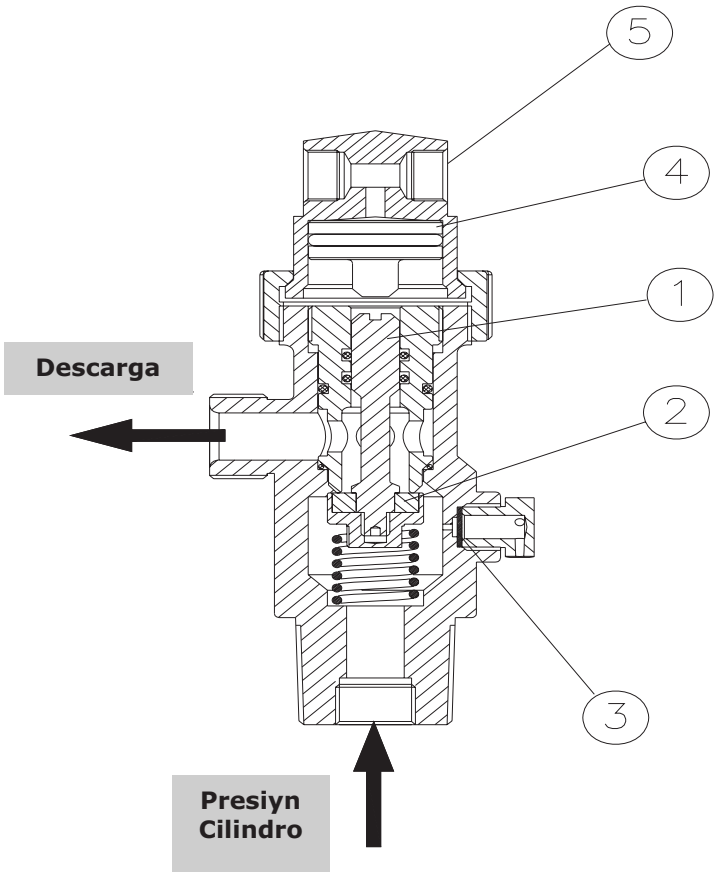
The design of the valve allows the assembly/disassembly of the heads when the cylinders are filled and pressurized.

The head (pneumatic or manual lever) should be removed in order to avoid accidental discharges during the installation or maintenance operations and whenever there is some kind of manipulation on the valve.

Installation:

The valve is supplied assembled on the cylinder. None of its components (with the exception of the release heads) should be dismantled. The assembly of the devices on the valve (discharge hose and release devices) will be done later following the same order as shown in its description.

Actuation by Pneumatic Head.



This system is only used with auxiliary cylinders.

The only way to activate valve is by making the piston move downwards (1).

When valve is at rest, pressure is retained by the sealing element (2) and the safety disk (3). When the pressure arrives through the pneumatic connections (5) above the piston of the pneumatic head (4), the piston moves downwards displacing piston (1) and opening the valve.

5.2.3 Carbon dioxide (CO_2) Pressure Gauge.

Description:

This device allows reading of the cylinder internal pressure. Scale 0-160 bar.

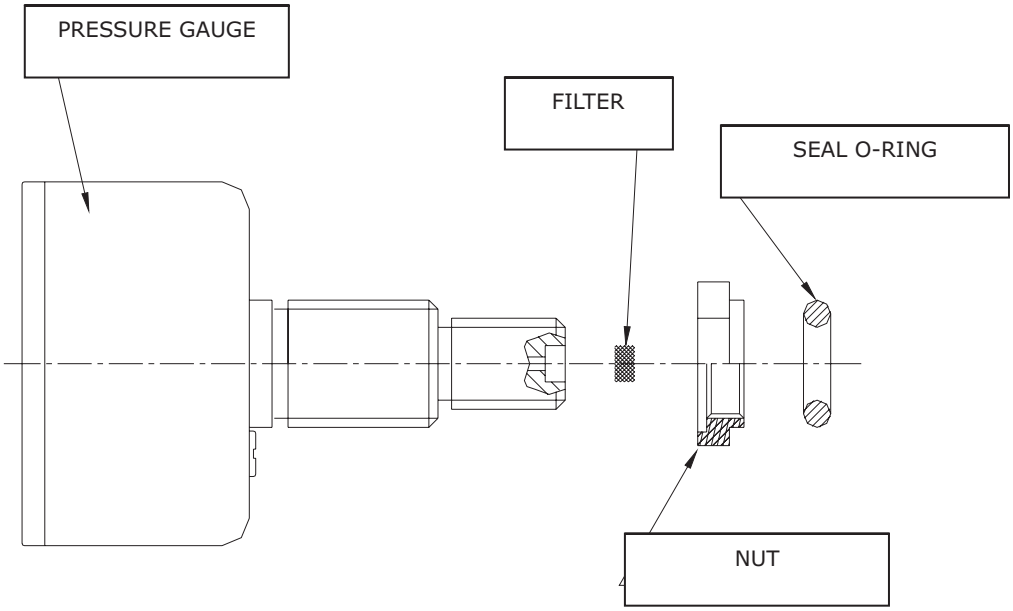


Fig. 5.2.3.1. *Pressure Gauge 0-160 bar*

Installation:

The pressure gauge is supplied factory mounted on the pilot cylinder valve. If for any reason you have to disassemble (for example, to remove solenoid valve), remove its protector cap by unscrewing by hand. Using a fixed wrench, loosen the fixing nut contained in the pressure gauge and valve body and remove the pressure gauge by unscrewing by hand.

Prior to starting Installation of the pressure gauge on the valve, check for the "O" ring seal and a fixing nut. Prior to connecting the pressure gauge, move the nut against the "O" ring to unscrew the first thread. Begin to thread the pressure gauge into its coupling by turning by hand, at the same time with the help of a fixed wrench tighten the fixing nut. In this way, the fixing nut pushes the "O" ring preventing its being ejected by cylinder pressure.

If during this operation, the fixing nut touches the valve body (it is detected because flattening of the "O" ring may not be filled) loosen the fixing nut a little and continue.

When gauge reaches the bottom and you observe that "O" ring is properly fitted, check the position of the lens and the pressure indicating needle. If the lens is not in its normal reading position, by holding the fixing nut with a fixed wrench so that it will not move, rotate the gauge until a suitable position is found. Once in position, tighten the fixing nut against the valve body so as to fix its position.

Check with soapy water for possible leakage for 10 minutes prior to completion of the operation.

5.2.4 Pressure Switch.

Description:

Pressure switch rated at 25 bar. Consists of a fill control element for the agent contained in the cylinder as it allows control of pressure drop produced by leakage or discharge by means of an electric signal.

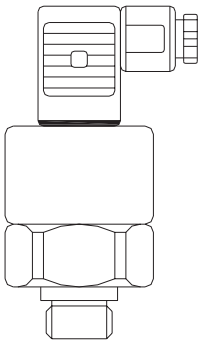


Fig. 5.2.4.1. *Pressure switch*

Installation:

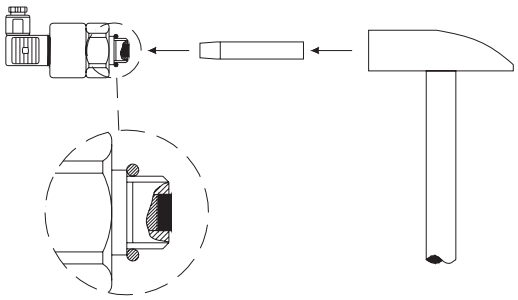
Mount the pressure switch into its housing on the opposite side to the valve gauge. Prior to this, remove the factory installed cap.

Slowly hand thread the pressure switch (check that sealing "0" ring is present) onto the coupling until reaching the small bleed housed inside valve. At that moment a slight pressure release will be heard. Loosen j turn until pressure release stops and then tighten quickly so as to prevent gas leakage. The threaded union does not require a sealing element as it is sealed by means of the O ring.

Tighten the pressure switch using a fixed wrench but do not force the joint.

Check for leakage for 10 minutes with soapy water prior to considering the operation complete.

If when installing the pressure switch, the released pressure ejects the "O" ring seal, push slightly the pressure switch filter as shown in the drawing.



Carry out the electrical connection when installation is complete. Specified in this manual in section 5.5 Electrical Installation.

5.2.5 Manifold discharge pipe.

Description:

Pipe where contents of all the bank cylinders are discharged and which directs the extinguishing gas to the appropriate pipe distribution system. Made of black steel pipe in accordance with ASTM. Nominal diameter between 3/4" and 4".Welded by the SMAW process under approved procedure. Tested at 200 bar. Supplied in black colour. Threaded outlets for connection to the piping system (1) Threaded connections for installation of check valves (4), pressure switch with locking device (2) and odorizer (6). Manifold is supplied with one blind cap (5). Threaded joining nut (3) is optional.

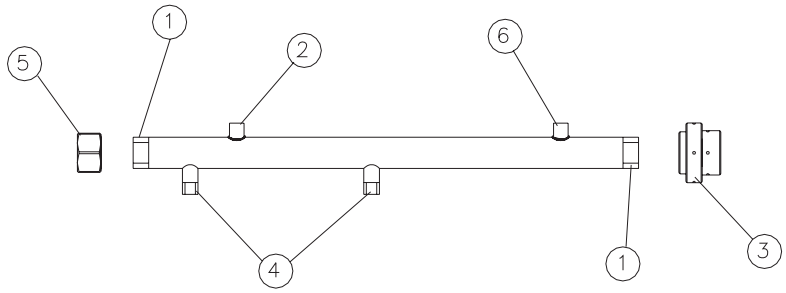


Fig. 5.2.5.1. *Discharge manifold*

Installation:

The manifold pipe is located above cylinder bank, on the squares directly fixed on the wall or on vertical support columns. Assembly of the manifold pipe is performed at the same time as the Installation of the bracket. Avoid positioning the manifold by initially connecting it to the distribution system as such operation may modify the elevation between the manifold connections and the location of bank cylinders. See 5.1.2. *Installation of Brackets* for further information.

All manifold threaded connections should be sealed with Teflon tape. Do not apply any Teflon tape to the two first threads.

5.2.6 ½" Carbon dioxide (CO_2) check valve.

Description:

Used in cylinder banks of 40'2, 67 and 100 litre capacity.

A device, which prevents the gas returning from the manifold pipe to the cylinders, thus ensuring a complete discharge of all the bank cylinders. Acts as a safety element during maintenance operations, in that, in case of having cylinders disconnecting and an accidental discharge produced towards the manifold, blocks the exit of gas.

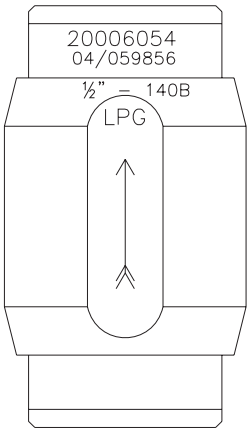


Fig. 5.2.6.1. ***1/2"*** *Check valve*

Installation:

Once the manifold is mounted onto the brackets, mount all the check valves.
They are always located between the discharge hose connected to the cylinder and the discharge manifold. To mount, apply joint sealing compound or Teflon tape to the manifold pipe threaded connection where the check valve is fitted. Do not apply to the two first rows of thread. Make the same operation on the male thread connection of the flexible hose. It is marked on the body of the check valve an arrow that indicates the sense of the flow. It must always be installed with the arrow towards the manifold.

Tighten the joint firmly using a fixed wrench.

5.2.7 ½" deviator.

Description:

As standard, it is only used in banks of 8 or less cylinders with master cylinder. It is installed between the outlet of the master cylinder and its release hose. During the activation, the system diverts one part of the pressure release by the master cylinder in order to discharge the auxiliary cylinders of the bank.

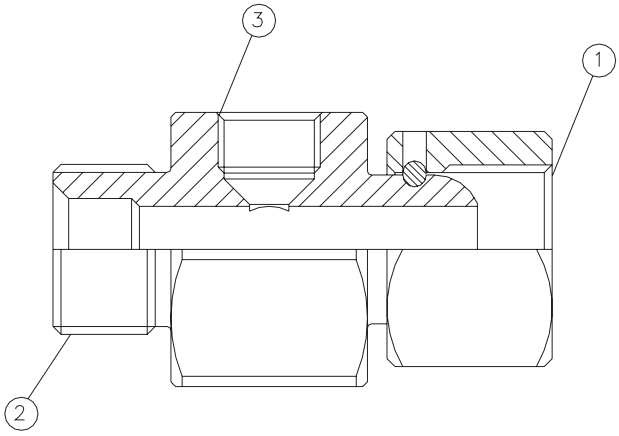


Fig. 5.2.7.1. *½" deviator*

Installation:

It is assembled by means of the connection (1) directly on the outlet of the master cylinder. The release hose is assembled directly on the connection (2). Connection (3) is for the j" hose feeding the pneumatic heads of the auxiliary cylinders. None of the connections in this device needs the use of sealing devices since they have spherical closing. It is advisable to use vasselin to make the thread adjustment easy.

5.2.8 High pressure slave cylinders.

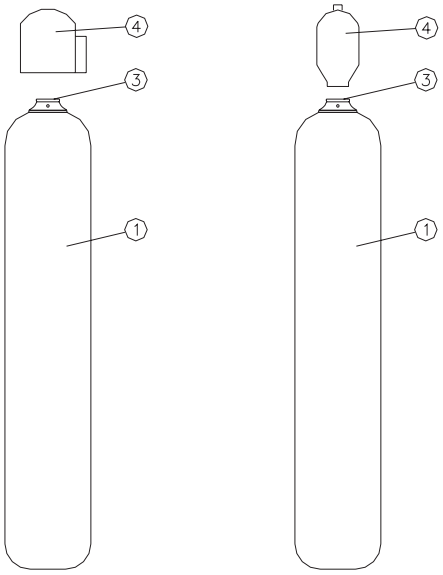


Fig. 5.2.8.1. *Carbon dioxide (CO_2) cylinders*

Description:

High pressure containers containing a fill of ***carbon dioxide (CO_2)*** extinguishing agent. Maximum filling ratio is 0'75 kg/litre. Cylinders of seamless drawn steel in accordance with specifications 1999/36/EEC, thermal treatment, with hydraulic test pressure of 250 bar. The cylinder capacities are 40'2,67,100 litre capacity. Self-contained cylinders of 5'0, 13'4, 26'8 litre volume are also available. All models are approved according to the applicable European Regulations (Π trade mark). Once the valve is assembled onto the cylinder collar (3) and the protection flange (5), the assembly is protected by a safety cap for transportation (4). All cylinders are provided with identification labels indicating handling instructions.

Installation:

The cylinder-valve assembly is supplied fully mounted. Place all cylinders onto the bracket. To prevent damage to the cylinders through accidental dropping, locate the front pieces of bracket prior to removing the protective caps. Tighten the front pieces allowing the cylinder freedom of movement. Next, remove protective caps (4). Remove the valve head cap.

Do not forget, when release system Installation is finished, fix the cylinders onto the bracket, tightening firmly. When the complete system installation is finished (including the release system) install and tighten manually all LPG valve head caps.

5.2.9 1/2" R2F hose.

Description:

Discharge pipe for **carbon dioxide (CO_2)** that connects the cylinders to the manifold pipe.

This model is used with self-contained cylinders and CO_2 batteries without weighing device.

1/2" nominal diameter made of synthetic rubber with two (R2) intermediate metallic braids and a external synthetic rubber coat that gives a resistance in front of the atmospheric agents.

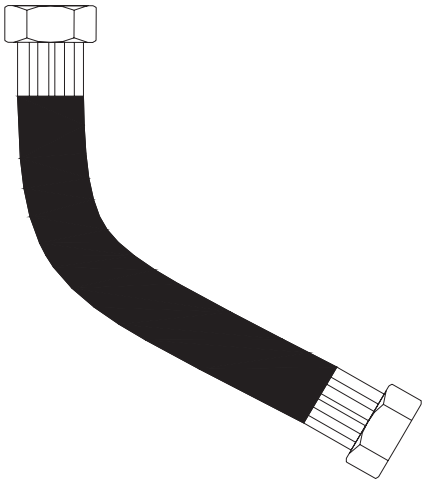


Fig. 5.2.9.1. *1/2" R2F Hose*

Installation:

The female end of the flexible hose is been adapted to the valve or the deviator device and it does not need any sealing type, although it is recommended to add Vaseline for the adjustment of the threads.

The male end is connected on the check valve and needs to add Teflon (PTFE) tape without covering the first threads to avoid clogging.

5.2.10 ½" Teflon (PTFE) discharge hose.

Description:

This flexible hose is been used for the same function as the R2F hose, but only in the batteries with weighing device system because its high flexibility. 1/2" diameter Teflon (PTFE) hoses fitted with brass ends and protected with an external stainless steel braid.

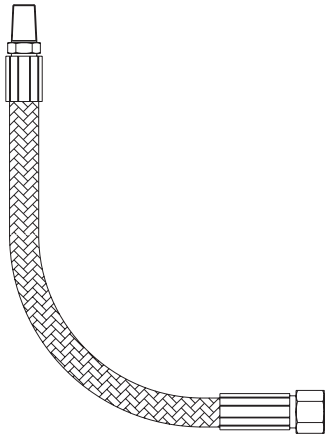


Fig. 5.2.10.1. *½" Rigid hose*

Installation:

The female end of the flexible hose is been adapted to the valve or the deviator device and it does not need any sealing type, although it is recommended to add vaseline for the adjustment of the threads. The male end is connected on the check valve and needs to add Teflon (PTFE) tape without covering the first threads to avoid clogging.

5.2.11 Pneumatic delay-time device.

Description:

Consists of a small volume cylinder (1) which valve (2) is fitted with a mechanical flow restricting element. The pneumatic delay-time device is designed to produce a delay period between the actuation of release and the actual discharge of the cylinder bank. Calibrated in as standard to a delay period of 30 +/- seconds. Incorporates a manual actuator to abort the time-delay (3).

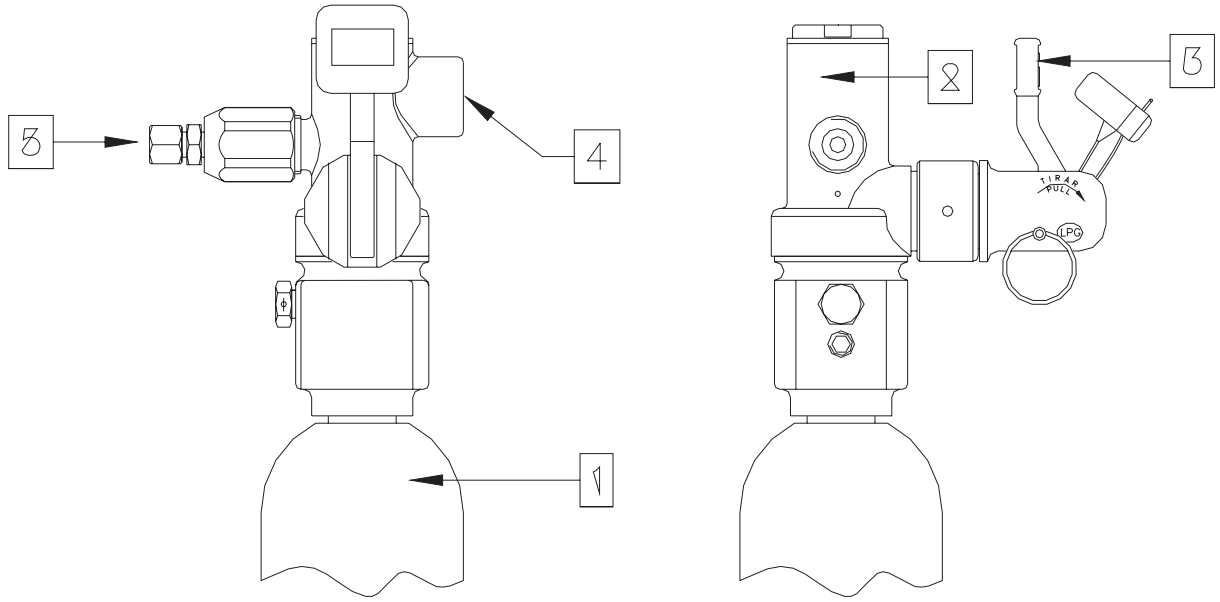


Fig. 5.2.11.1. *Pneumatic Delay-Time Device*

Installation:

The time-delay device should be inserted on the release line, between the pilot cylinder and the first slave cylinder of the system. Connect the pilot cylinder to the delay-time device through port (4), using a special adapter or 1/4" flexible hose, as indicated in the drawings. Outlet port (5) must be connected to the first cylinder of the battery.

5.2.12 Diverter.

Description:

Device used in *carbon dioxide (CO_2)* release systems fitted with a time-delay and a pneumatic siren. Enables the actuation of an alarm pneumatic siren during the delay time. When the delay time is over, it shuts off the pneumatic supply to the siren and diverts it towards the pipe system which goes to the nozzles. Provided with a threaded connections for the discharge hose (1), the check valve (2) the line to feed the siren (3) and the line coming from time-delay device (4).

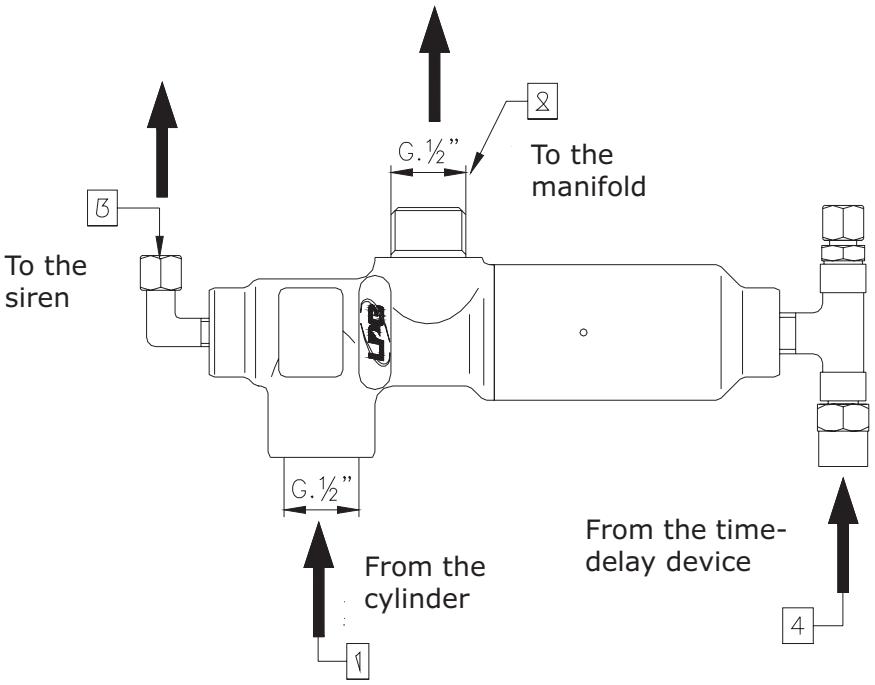
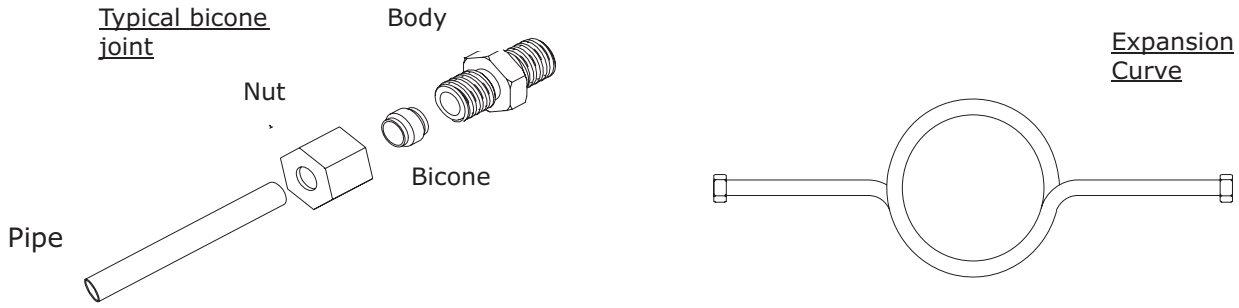


Fig. 5.2.12.1. *Diverter*

Installation:

Mount onto the discharge check valve through port (2). The connection requires the application of Teflon (PTFE) tape to the connection. Connect the discharge hose onto port (1), apply Teflon tape. Connect 4x6 copper tube between the delay-time device and the inlet (4) and another copper pipe between the siren and connection port (3). For 4x6 copper pipe connection to ports (3,4) mount j" gas in ternal biconical connectors, supplied by LPG, together with the diverter. The copper conduits should appear straight or curved at 90ϵ. Observe that the pipe is not flattened or damaged along all its length so as not to obstruct the flow of pressure. On straight runs and with bends no longer that 300 mm make an expansion bend in the middle, that is, a full circumference which will absorb the water hammer. The copper pipe is sealed by means of a bicone. Fixing of the bicone to the copper pipe should be performed on a workbench and never in situ as it is the way to ensure an accurate bicone joint on pipe thus preventing leakage. Once adjusted on the bench, mount on the circuit ensuring that the pipe and bicone reach the seat of the coupling. Tighten nut using a fixed wrench.



5.2.13 Pressure switch with locking device.

Description:

The pressure switch closes or opens an electric circuit when a gas discharge from the manifold pipe takes place. The electric signal may be monitored by a control panel or used to operate and/or shut down other electrical devices. Once activated it may only be re-armed manually by removing the sphere (1), which incorporates the latching mechanism. Re-assembly should be performed at the storage location on the pressure switch itself.

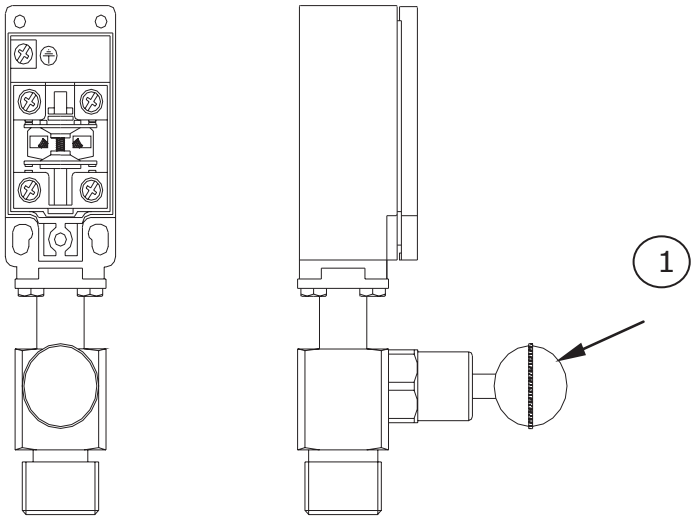


Fig. 5.2.13.1. *Pressure switch with locking device*

Installation:

Mounted on the manifold pipe. Apply Teflon tape to the threaded connection taking care not to cover the two first threads. Tighten the union using a fixed wrench on the brass body, never on the connection box. The electrical connection should be performed when installation Installation is complete in accordance with the specifications in section 5.5 in this manual *Electrical Installation.*

5.2.14 Odorizer.

Description:

It is a device installed on the manifold which supplies a scented smell when the system is released. Since Co2 is a colourless and odourless gas, the scented smell allows people to detect the presence of gas in case of a release.

The odorizer is supplied filled with the essence and is installed directly on the manifold. When the system is released, the pressure expels the cover (3) and allows its contents to mix with the discharge flow.

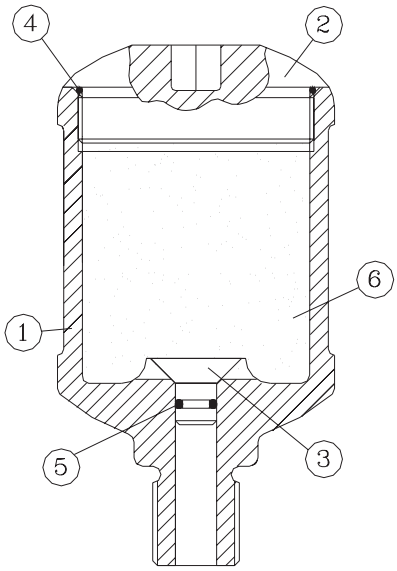


Fig. 5.2.14.1. *Odorizer*

Installation:

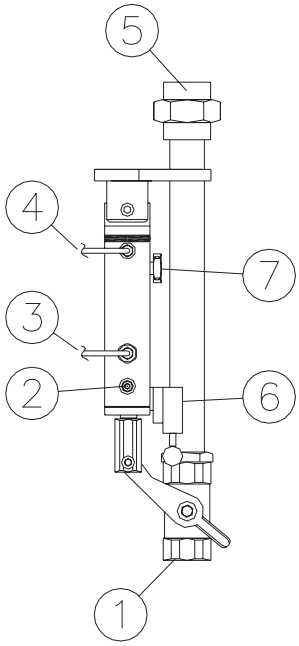
By its threaded connection it is assembled directly on the manifold with some Teflon tape. The odorizer must always be installed on a vertical position (threaded connection downwards and cover (2) upwards) and the nearest to the manifold outlet.

5.2.15 Selector Valve.

Description:

A pneumatic device which allows coverage of several hazards using only one cylinder bank. The opening of this element is produced during the actuation of the release system. The inlet of the release line is achieved through connection port (4) and outlet through the connection port (3). Port (2) allows the air retained inside the piston to escape during the opening operation. The opening of the selector valve is attained prior to opening of the slave cylinders. Each selector valve directs extinguishing agent flow to a different hazard and to a different pipe system.

Optionally the selector valve can have an electrical contact (6) for remote control of its position (open or closed). The pneumatic piston has a venting screw (7) to cancel the effect of vacuum while closing manually the valve.



the manual

Fig. 5.2.15.1. Selector Valve

Installation:

Selector valves incorporate threaded connections in (1) and (5) for diameters up to 2" and welded connections from 2 1/2".

Connect the selector valve between discharge manifold and pipe system protecting a certain hazard. First assemble selector valve onto manifold pipe (1). If the selector valves are threaded, apply Teflon tape to the threaded union (1) and tighten using a suitable wrench (fixed, Stensson, Monkey wrench). Connect to pipe system by (5).

The pilot pneumatic release line connection to ports (3) and (4) is explained in section 5.3.10. *Release system for selector valves.*

5.2.17 Load cell weighing device system.

Description:

Weight control devices are designed to allow continuous control of cylinder charge condition. The equipment gives an alarm signal when there is a loss of more than 5% or 10% of initial charge, in accordance with ISO, CEPREVEN and NFPA standards.

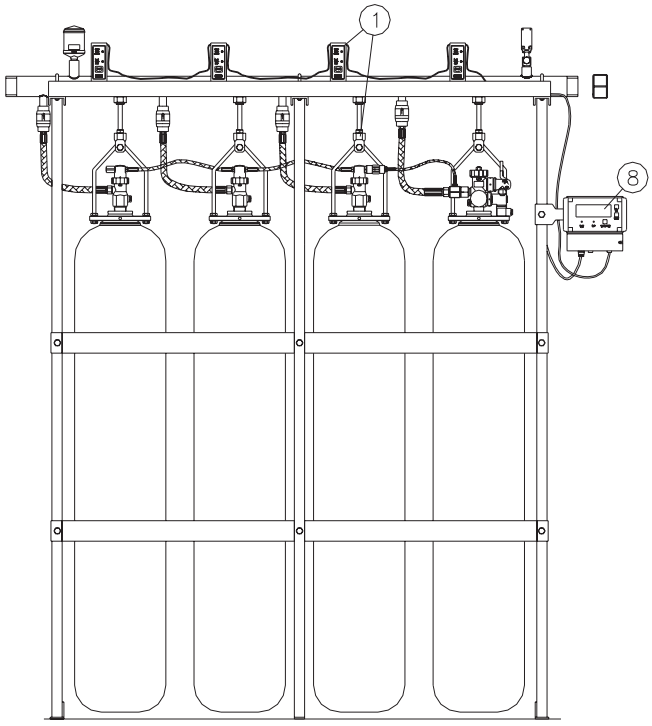


Fig. 5.2.17.1. *Electronic weighing device system*

Systems are provided with a central unit that can be connected to the fire station as well as with several weight control units, one for each cylinder to be controlled. Weight control units formed by a load cell which allows detection of leakages with a resolution of 1 kg. Load cell incorporates an extensometer gage. All weight control units are connected to central unit, by means of a BUS.

This equipment allows you to check from central unit real charge, nominal charge, actual extinguishing charge, minimum permissible weight and state of each weight control unit.

Each central unit is designed to control a maximum of 31 weight control units. More central units shall be supplied for those installations requiring more weight control units. Each central unit has to be considered as totally independent equipment.

The equipment described has been developed to carry out cylinder charge control. Thus allowing to know the actual charge weight contained. Central unit consults in a continuous manner condition of each cylinder and receives the information from weight control unit mechanically associated to it. For this purpose each unit is assigned an internal address. Address assignment is carried out at equipment commissioning.

In the event of failure of power supply the equipment keeps configuration in its memory but will not carry out weight control. The system will keep operating without any need of supervision at the moment power supply is restored.

Installation: ***Every weighing device system is supplied with the commissioning and installation instructions.***

5.2.18 Mechanical system for weighing monitor.

Description:

Mechanical system for monitoring the level of gas in each of the cylinders which are part of a bank of cylinders. The way it works is based on the weight reduction of a cylinder when there is a gas loss. This system does not consider the real weight of the cylinder.

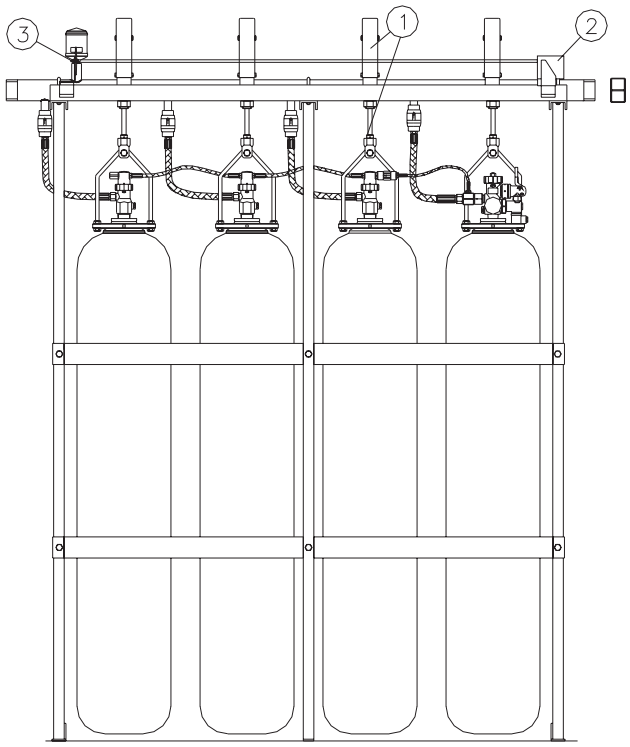


Fig. 5.2.18.1. *Mechanical weighing device system*

Each cylinder is hanging from a mechanical control module (1). A 10% loss is enough for the module to issue an optical signal showing the failure (by the falling of the metallic cover of the module). If necessary, the system can be supplied with a photocell (2) and a mirror (3) allowing the monitor of the system by means of external devices (control panel) and releasing other alarm systems both optical and acoustic. One single photocell allows monitoring banks of up to 10 meters length.

The installation and commissioning of this weighing device system is very easy and allows manual adjustments to modify the sensitivity of the control modules.

Upon order confirmation and coming from manufacturer it is possible to supply mechanical weighing modules for different kinds of cylinders and levels of weighing lost.

Installation:

With each mechanical weighing device instructions for assembly and commissioning are handed out.

5.3 RELEASE SYSTEM.

This is the system, which allows command of gas discharge contained in the cylinders. The *carbon dioxide (CO_2)* standard release system is pneumatically operated. Annex 1 contains **as an example,** drawings of the following *carbon dioxide (CO_2)* release systems:

- ☛ Sketch for discharge and release system: *carbon dioxide (CO_2)* cylinder bank provided with master cylinder.
- ☛ Sketch for discharge and release system: *carbon dioxide (CO_2)* cylinder bank provided with pilot cylinder.

The drawings mentioned above show the connection of release systems of different complexity. However, thes e drawings are included **as examples.** Therefore, for installations provided with specific drawings, such drawings will prevail.

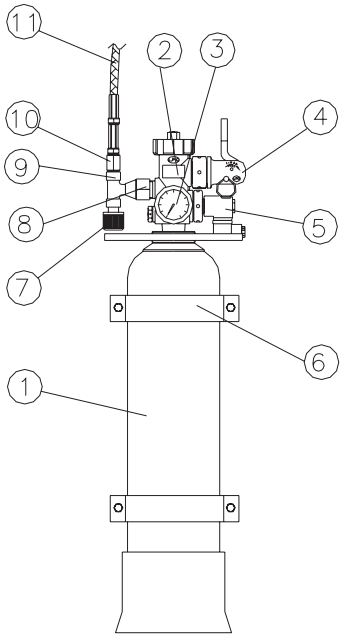
The pneumatic release consists of one master cylinder or one or two pilot cylinders, with a pilot valve incorporated into each. The pilot valve combines different release devices, such as manual release devices, electric actuation by means of solenoid valve, which once activated carries out the opening of the slave cylinder valves. This is a flexible system, which may incorporate more than one pilot cylinder and command release from several cylinder banks simultaneously.

Components which may be included into a *carbon dioxide (CO_2)* release system and the Installation of each are described as follows. Installation is performed in the order the parts are described.

5.3.1 Pressure pilot cylinder.

Description:

A pilot cylinder (1), equipped with an LPG 128-90 valve (2), filled with dry nitrogen at 100 bar. It can be manually actuated (4) and electrically actuated by solenoid valve (5). Once the pilot cylinder discharge is activated, nitrogen flows through release line to the pneumatic release heads mounted on the bank slave cylinders. The valve incorporates a pressure gauge (3). Once activated **it is not possible to interrupt total discharge** of the cylinders.



Pos	Description
1	N2 pilot cylinder
2	LPG 128-90 valve
3	Pressure gauge
4	Manual lever
5	Solenoid valve
6	Rack with straps
7	Depressurization valve 1/4”
8	Reduction 21’7 to 1/4” H-H
9	Tee 1/4” male to 2 x 1/4” female
10	Coupling 1/4” to hose
11	PTFE release hose 1/4” x 700

Fig. 5.3.1.1. *Pilot Cylinder fitted with valve model LPG 128-90*

Valve operation coincides with description in section 5.2.1. ***"Carbon dioxide (CO_2) LPG valve: LPG 128-20”and LPG 128-30".***

Installation:

Fix the bracket of the pilot cylinder in the approximate position shown in the drawings. The height of cylinder bracket should be adequate for a possible manual operation. Unpack pilot cylinder, fix it onto its bracket and remove the protection cap. When installed the pressure gauge should be clearly visible and access to the manual release systems should be free of obstacles. Unscrew the pilot valve head cap to prevent accidental discharge during Installation of the rest of release system components. Upon completion of all handling of the release system, replace the pilot valve head cap.

5.3.2 Manual lever release.

Description:

A device, which allows manual actuation of the cylinder bank pilot cylinders. It consists of a lever (1) that manually operated backwards and downwards to push a needle (2) against a release disk located on the pilot valve body. The bursting of the disk opens the valve. It incorporates a safety pin (3) to prevent accidental discharge.

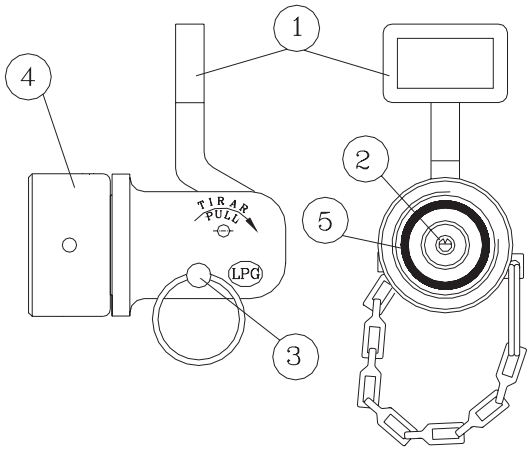
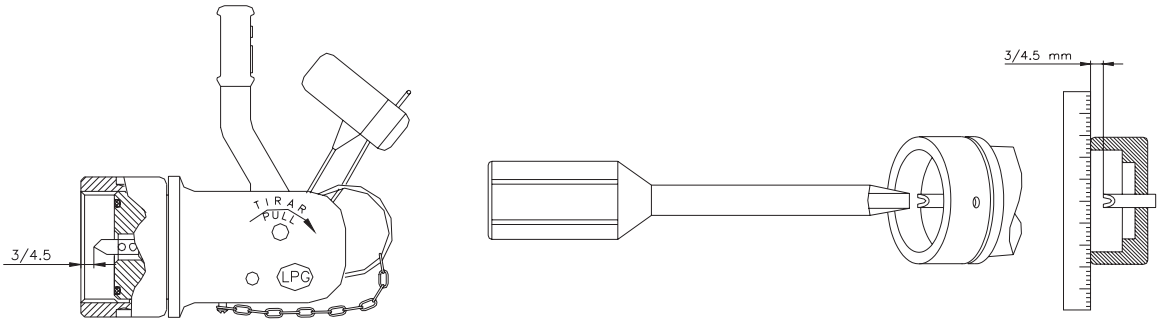


Figure 5.3.2.1. *Manual Lever Release*

Installation:

Check that the seals assembled on the safety pin (3) are not damaged. Check that the "O" ring (5) is in position. The release is placed on the pilot valves on the connection port indicated in 5.2.1. Use an appropriated rounded spanner for Installation and do not apply sealing compound to threaded fitting (4) as sealing is achieved through the "O" ring (5). It is recommended to apply a little vaseline to the joint to facilitate Installation.

Manual actuation devices should be installed at normal operating height, in highly visible locations. They should be protected against being actuated accidentally. Each lever manual release device should be clearly marked indicating the protected zone that it serves.



Note:	***Prior to installing the manual release onto the valve check that the piston is deep seated inside its housing, by pushing down with a screwdriver. Afterwards, check using a ruler that the needle is deep seated inside 3'0-4'5 mm as it is shown on the drawing.***

5.3.3 Solenoid valve.

Description:

An electric device, which allows opening of the LPG family of valves. Connects (1) to the pilot cylinder valve or self-contained valve and allows their actuation by means of an electric signal sent by a control panel or by a push button release. Consists of a coil (3) mounted on a stem. When the coil energises the internal core is drawn up, opening the valve. The coil is fed electrically by means of the connector (4). There are two models available, one for normal operations and one for explosion proof operations. This device may be disassembled even when pilot cylinder is pressurised.

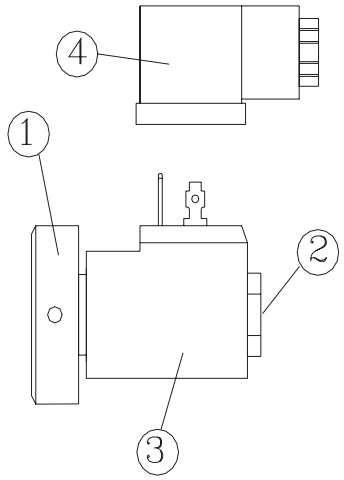


Figure 5.3.3.1. *Solenoid Valve*

Installation:

The solenoid valve is delivered mounted on the pilot cylinder valve or self-contained cylinder valve. Do not perform the electrical connection until the pneumatic Installation for all the installation is completed (see 5.5. *Electrical Installation*).

In case of having to disassemble for operation test, remove the connector (4), loosen the nut (2) and remove the coil (3)

Note:	***LPG does not recommend removing the solenoid valve from the pilot cylinder, in case of malfunction, send the valve + cylinder + solenoid valve assembly to LPG.***

If for any reason, breakdown or under expressed instructions of LPG Technical Service it is essential to remove solenoid valve from pilot cylinder valve, ***first***, ***disassemble the blind cover (14) and the cap (15)*****.** As indicated in fig. 5.2.1.1. when the pressure gauge is disconnected, the pressure supply to the solenoid valve is shut-off. ***This operation should be performed with great care and carried out carefully to prevent false operation*****.** Therefore, the operator should stand sideways to prevent a sudden ejection of the pressure

gauge. Discharge of the pilot cylinder or the self-contained cylinder may occur and cause discharge of the cylinder bank. To prevent this, dismantle the head cap of the pilot cylinder valve or self-contained valve. Next, dismantle the connector (4), the nut (2), remove the coil (3) and finally loosen the fixing nut (1) with the appropriate round spanner. Now it is possible to remove the rest of the solenoid valve. Installation is carried out by following the disassembly procedure in reverse, with the installation of the cap (15) and the blind cover (14) being the last operation.

After Installation a solenoid valve check that there is no leakage by applying soapy water to all the solenoid valve body, previously removing connector and coil. Check likewise for leakage on the valve head (head orifice) prior to notifying that work is completed. The equipment remains in service when the valve head cap is replaced.

5.3.4 LPG110 Pneumatic release heads.

Description:

Device that installed directly on the valve of the auxiliary cylinders it allows the discharge of the cylinder for pneumatic means.

The pneumatic head is equipped inwardly with an internal piston (2) and with two or three pneumatic connections (1) depending on the position that occupies in the battery. Once pneumatic pressure arrives above the piston (2) it produces the opening of the valve associated to the head.

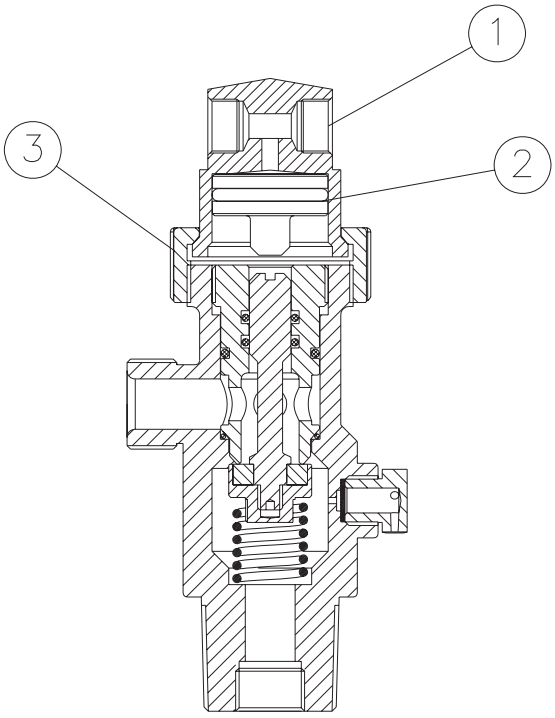


Figure 5.3.4.1. *Pneumatic release heads*

Installation:

To mount it on the cylinder, loose the cap of the head by hand (3), introduce the head in the interior and thread the head by hand on the valve again. This union doesn't specify the use of sealing joints. On the pneumatic connections (1) settle the flexible hose of the release circuit or the short decompression screw directly depending the position occupied by the head. This union neither use sealing joints.

5.3.5 Decompression screw.

Description:

After an activation of the cylinder bank, the pneumatic release circuit remains pressurised because the discharge from the master or the pilot cylinder. To decompress the circuit in a safe and guided way, the decompression screw is operated.

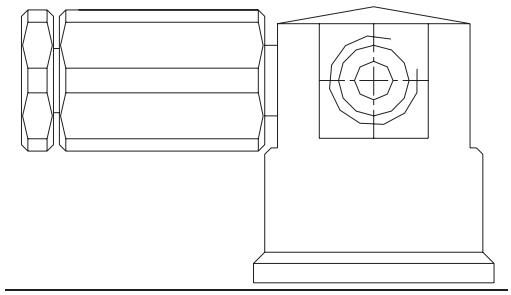


Figure 5.3.5.1. *Decompression screw on pneumatic head*

Installation:

Thread the part using a fixed wrench and do not apply sealing compound to the joint, as the seal is conical. Their location is determined in the release system drawings.

5.3.6 R 1/4" Decompression valve.

Description:

The decompression valves for pneumatic release systems prevent over pressurisation on the release line produced by micro-leakage producing accidental discharge of the cylinder bank. At rest this device allows the external exit of micro-leakage but in the case of a genuine actuation it automatically closes preventing the loss of pressure on the release circuit.

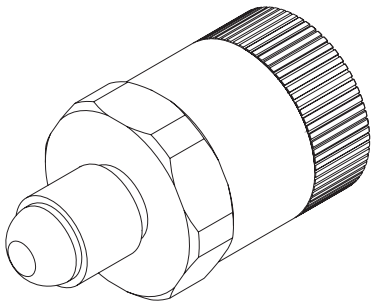


Figure 5.3.6.1. *Decompression valve*

Installation:

The 1/4" decompression valve should be installed in accordance with the drawings. Generally mounted on a "T" at the nitrogen cylinder valve outlet and the first hose on the release line. The connection does not require sealing.

This device is only used in cylinder banks that use pilot cylinders. In cylinder banks that do not use a pilot cylinder the function of this part is achieved by similar devices integrated in other cylinder bank components.

5.3.7 Release line Teflon flexible hoses.

Description:

1/4” diameter Teflon hoses fitted with brass ends used to direct the release system gas from the master cylinders or pilot cylinders to all slave cylinders. The flexible hoses are designed for a working pressure of 260 bar and a burst pressure of 780 bar. The minimum curvature is 30 mm and available in two lengths, 350 and 700 mm.

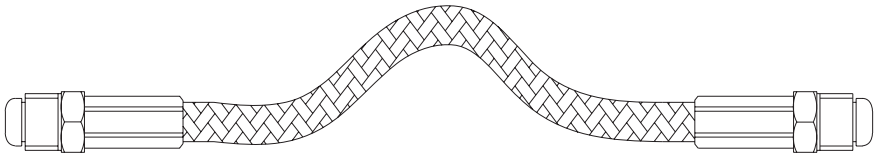
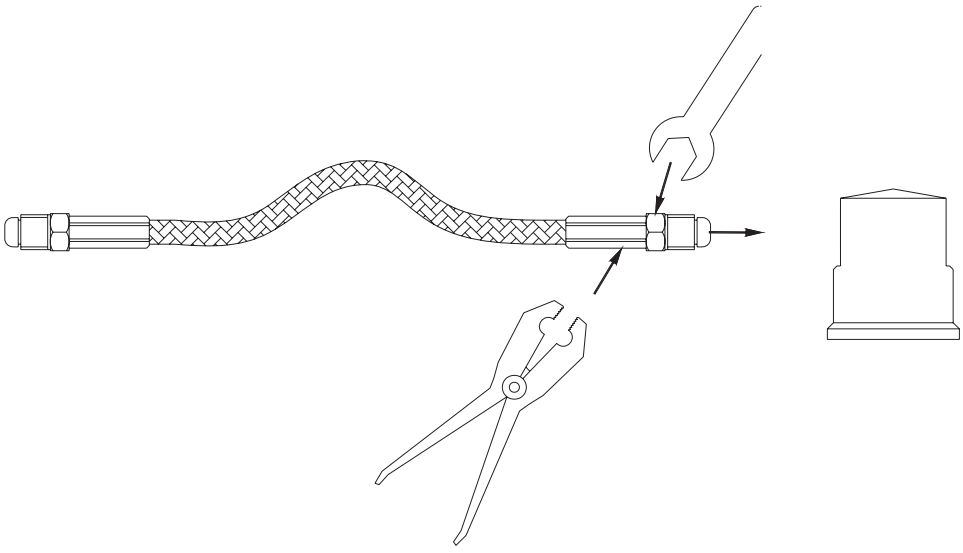


Figure 5.3.7.1. *Teflon flexible hoses*

Installation:

They are mounted between the release head pneumatic couplings. Insert the decompression screw or the decompression valves in accordance with the drawings. Tighten the threaded connections using a fixed wrench but do not apply sealing compound. Add vaseline to the joint to facilitate the threaded connection.

NOTE:	***Avoid twisting flexible hoses during the Installation operations. therefore, hold the coupling cap with a pair of pliers while the connection is tightened by a fixed wrench.***



5.3.8 Solenoid valve + manual release.

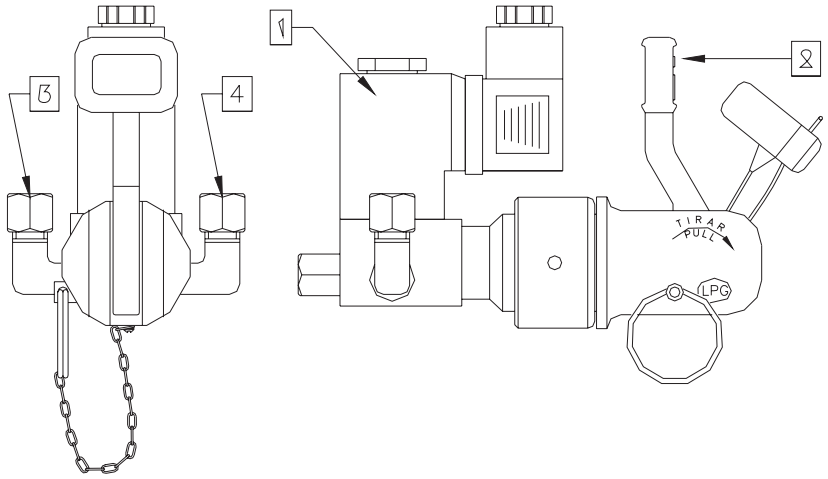


Figure. 5.3.8.1. *Solenoid valve + Manual Release*

Description:

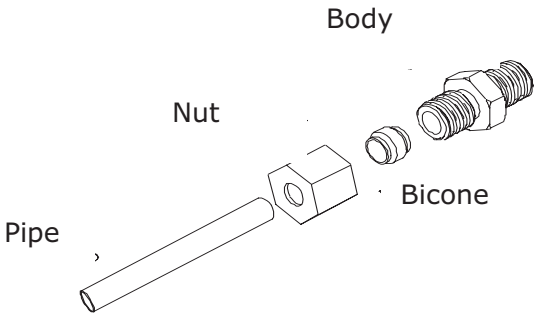
An electric and manual actuation device for operation of the selector valves. The assembly consists of a solenoid valve (1) + a manual release (2). The manual opening enables system operation even in the event of an electrical failure. It is important to have each valve marked indicating zone that it protects so as to prevent misunderstanding in the case of manual operation. Its function is to select the selector valve assigned to be opened for cylinder banks covering more than one hazard. For further description of the solenoid valve see 5.3.2. For further description of manual release see 5.3.3.

Installation:

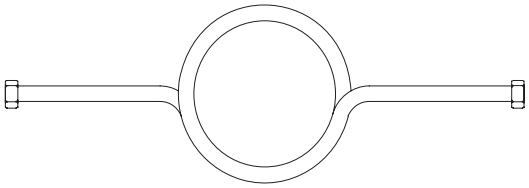
These devices are always mounted on a support fixed to the wall at a suitable height for manual actuation. Position the valve in such a way that the manual release is always be accessible. Fix the valve to the support using through bolts. Connect a 4 x 6 copper pipe, from the pilot cylinder to the inlet (3) and connect the outlet (4) to the appropriate selector valve, in accordance with the installation drawing.

Attention:	***If there is a mistake on connection 3 and 4, the selector valve will be open independently of the activation or not of the solenoid valve + manual release.***

Copper conduits should be straight or 90є curved. Observe that the pipe is not flattened or damaged on curves so as not to obstruct passage of pressure. On runs longer that 300 mm carry out an expansion bend in the middle, that is, a full circumference which will absorb the water hammer. The sealing for the copper pipes by means of a bicone. The fixing of the bicone to the copper pipe should be performed on a workbench and never in situ to ensure an accurate bicone grip on the pipe, thus preventing leakage. Once adjusted on the bench, mount on the circuit ensuring that pipe and the bicone reach the seat of the coupling and tighten the nut using a fixed wrench.



Bicono type joint



Expansion Curve

5.3.9 Release system fitted with delay-time device + pneumatic siren.

Description:

Some installations require to complete delay time with a pre-warning discharge pneumatic siren. In this case, a time-delay assembly (1) and siren (2) are installed. This assembly requires a diverter device (3) for its proper function. The siren is fed from one of the bank cylinders (4) during the delay-time, until the delay-time valve opens and the release line gas enters the diverter and shuts off the gas supply to the siren. At the same time, the remaining cylinders open and all extinguishing agent is discharged towards the manifold (5). The copper pipes (10, 11, 12) connect the diverter, time-delay, pilot cylinder and siren. The connection between the parts may be carried out in different configurations. Some copper runs may be replaced by j" flexible hoses or replace the adapter (8) by another connection accessory.

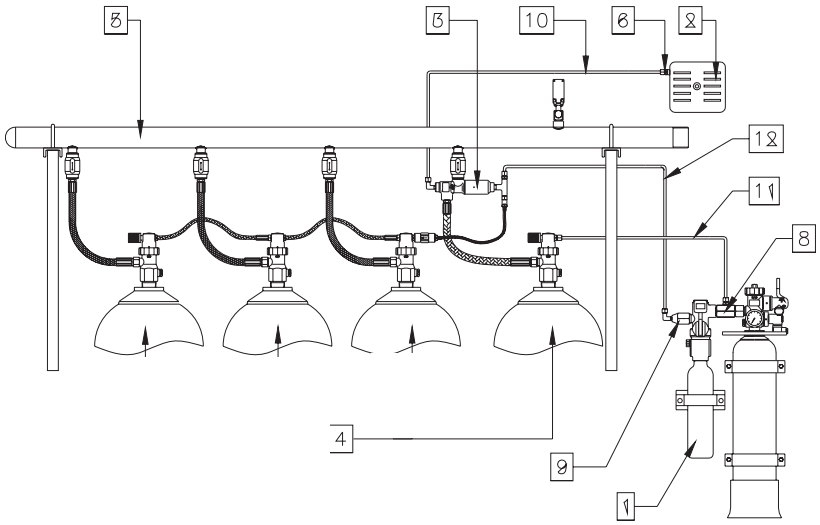


Figure. 5.3.9.1. *Release system fitted with time delay device + pneumatic siren*

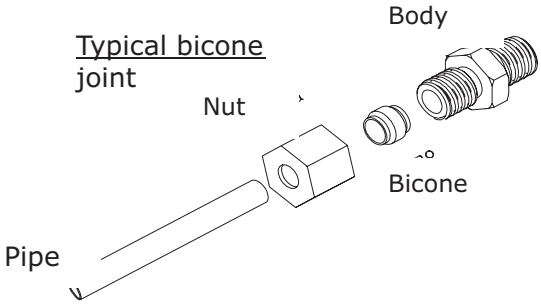
Installation:

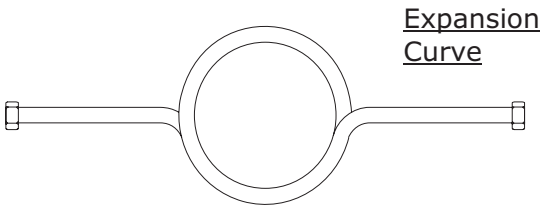
For different configuration Installation to that shown in above figure, consult the specific installation drawing.

Connect the diverter (3) onto the check valve on the first bank cylinder. Connect the discharge hose to the diverter and then to the cylinder. The hose for this cylinder will be a little shorter (310 mm length) than that for the others. Next, connect the adapter (8) onto the time-delay inlet and the reducer (9). Next, connect the pilot cylinder (13) and the time-delay by means of the adapter.

Position the siren in its final location (always inside the protected area), check that the siren input port (6) is provided with a 1 mm diameter threaded diaphragm. Except the union between the extension (8) and the valve of the cylinder pilot (13), all of the threaded unions that are mentioned must be sealed with tape of Teflon (PTFE) taking care of not covering the first threads in order to avoid cloggings.

Once all the component assembly has been fixed, make all the copper pipe connections: from the siren to the diverter (10), between the adapter and the first bank cylinder (11) and between the time-delay device and the diverter (12). The copper conduits should appear straight or curved at 90ϵ. Ob serve that the pipe is not flattened or damaged along all its length so as not to obstruct the flow of pressure. On straight runs and with bends no longer that 300 mm make an expansion bend in the middle, that is, a full circumference which will absorb the water hammer. The copper pipe is se aled by means of a bicone. Fixing of the bicone to the copper pipe should be performed on a workbench and never in situ as it is the way to ensure an accurate bicone joint on pipe thus preventing leakage.





5.3.10 Release system for selector valves.

Description:

The installation of selector valves (1,2) onto the discharge manifold (3) allows the coverage of several hazards with one single cylinder bank. The release system connection for the selector valves depends on the number of selector valves and the number of cylinders which are to be discharged through each valve. Use the specific installation drawing for the system to be mounted. In the example represented in above figure, the cylinder bank covers two zones under the fire hazard. Both zones require all four bank cylinders for their protection. Once the pilot cylinder (6) is released, gas flows to the solenoid valve + manual release (4,5).

- When the solenoid valve actuated is (4), the gas flows to the selector valve (1). The selector valve opens and the gas continues to flow through the release line until it opens the four cylinders. *Carbon dioxide (CO_2)* extinguishing agent is discharged towards manifold and comes out through opened selector valve (1) towards the pipe system directed to appropriate zone.

- When the solenoid valve actuated is number (5) the operation of cylinder bank is similar to above operation but discharge is generated through the selector valve (2).

The solenoid valves + manual release (4,5) may be electrically or manually operated. It is important to have each valve marked indicating the zone that it protects so as to prevent the misunderstanding in case of manual operation. Connections between the pilot cylinder and the cylinders are carried out with copper pipe (7). A non-return valve (8) is located on the outlet of selector valve release line. The release line is provided with a decompression screw (9) and a depressurisation valve (10).

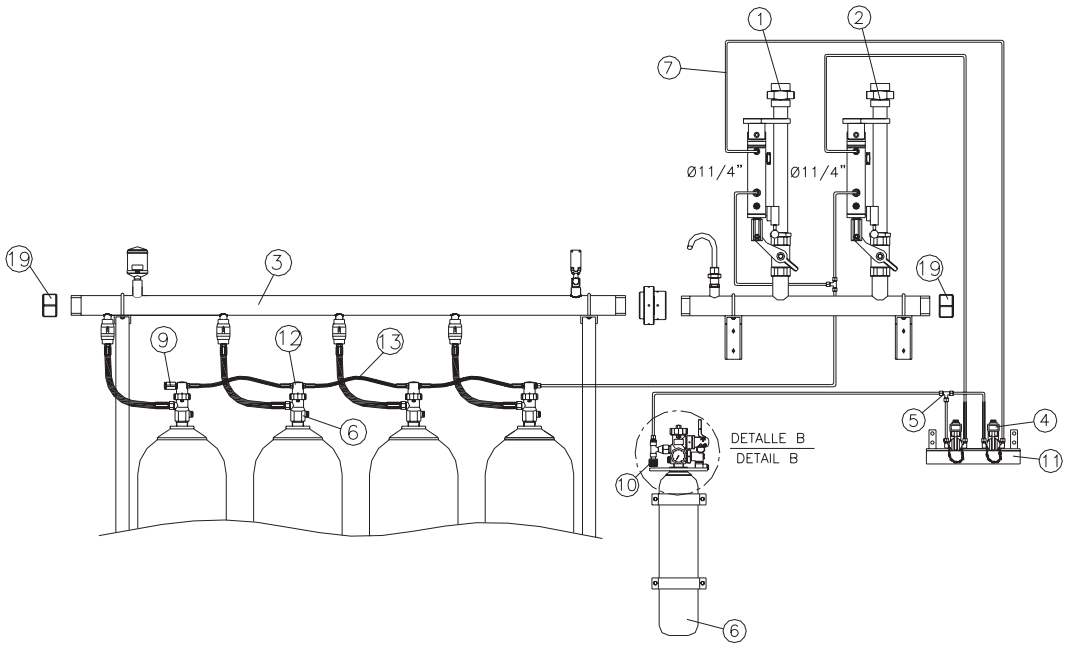


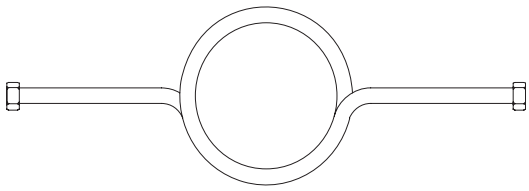
Figure. 5.3.10.1. *Release system with selector valves*

Installation:

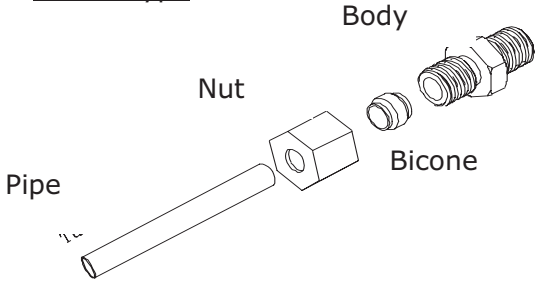
Once the storage system is installed (bracket, cylinders, manifold, selector valves and connection elements) proceed to mount the release system. Fix the bracket for pilot cylinder and tighten the cylinder to it (6). Mount the support (11) and install the solenoid valves + manual release (4,5).

Mount the pneumatic heads (12) on the cylinders. Mount the outlet pilot cylinder "T" and depressurisation valve (10) and decompression screw (9). Join the cylinders by flexible hoses (13). Lastly, install the copper pipe (7). Copper conduits should be straight or 90є curved. Observe that the pipe is not flattened or damaged on curves so as not to obstruct passage of pressure. On runs longer that 300 mm carry out an expansion bend in the middle, that is, a full circumference which will absorb the water hammer. The sealing for the copper pipes by means of a bicone. The fixing of the bicone to the copper pipe should be performed on a workbench and never in situ to ensure an accurate bicone grip on the pipe, thus preventing leakage. Once adjusted on the bench, mount on the circuit ensuring that pipe and the bicone reach the seat of the coupling and tighten the nut using a fixed wrench.

Expansion Curve



Bicone type

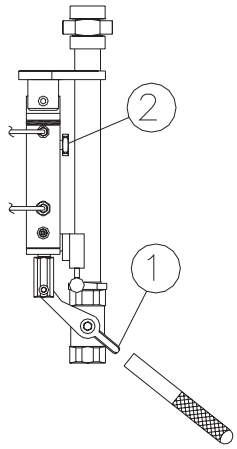


With regard to the electrical installation, it is important not to confuse the electrical connections of the solenoid valves + manual release (4,5). Otherwise it is possible that the extinguishing order dictated by the detection system may produce discharge of extinguishing agent into a different enclosure from that specified. Therefore, it is advisable to identify separately each solenoid coil.

IMPORTANT: It is advisable that the length of cables belonging to each solenoid valve be such that it will not be possible to mix up their position (the long cable for the solenoid valve which is farthest away and the shorter cable for the one that is nearest).

Test:

During the installation of the selector valves, manually test the movement for each selector valve that makes up the system. Open and close to check that the selector valve movement is clear and does not strike any movable or fixed part or itself (walls, copper pipes, etc.).



? ***To open and close manually an LPG selector valve***
The valve is fitted with a connecting rod (1) connected to the valve piston. A lever is connected to the free end of the connecting rod. When the lever is activated upwards the piston moves down and the selector valve opens. To close the selector valve, operate lever the downward until the piston is inserted into its housing to reach the end. LPG supplies selector valves provided with a lever of this type. In order to avoid the vacuum effect inside of the pneumatic piston unscrew the venting screw (2). After the test do not forget to tight the screw again.

Pneumatic test.

Refer to the sketch enclosed at beginning of this section.

1st) Disconnect the pneumatic supply between the selector valves and the release heads on heads side. Carry out this operation for all selector valves otherwise there is a risk of an accidental discharge.

2nd) Plug blind the free end of conduits feeding the release heads.

3rd) Disconnect the pneumatic supply between the pilot cylinder (6) and the solenoid valves + manual release (4 or 5) on the cylinder side. In their place connect a nitrogen pressure source or clean and dry compressed air set at 10-15 bar.

4th) Open slowly the pressure route from the pressure source. Now the pressure is retained by the solenoid valves + manual release (4 and 5).

5th) If the coil of one of solenoid valves, for example (4) is energised together with the pressure source indicated, it must be observed that the associated selector valve (1) opens by the effect of the pressure. Now check this pneumatic circuit for integrity with the help of soapy water.

6th) Shut off the pressure supply from the pressure source and depressurised the line by energising the solenoid valve (4) tested. To finish manually close the valve with the help of the lever supplied with the selector valves.

7th) Repeat the process with every selector valves in the system.

8th) To finish, leave the pneumatic release system connected in accordance with the drawing specifications. Pay special attention not to confuse connections between the selector valves and the bank cylinders.

5.4 DISTRIBUTION SYSTEM.

This is the assembly of pipe and fittings, which directs the gas discharge from the cylinders to the protected zone.

5.4.1 Pipe and fittings.

- Pipes should be installed in accordance with the isometric drawing accompanying the project. Measurements, dimensions and pipe quality indicated in the drawing have to be complied with, as are any modifications relating to pipe dimensions or measurements that would impair system operation. In case of any modification being required, the engineering department responsible for the system design should be notified as appropriate.

Piping shall be of metallic non-combustible material having physical and chemical characteristics such that its deterioration under stress can be predicted with reliability. Where piping is installed in severely corrosive atmospheres, special corrosion –resistant materials or coatings shall be used.

The pipe system should comply with the pressure requirements specified in table below. ASTM A-106grade A, B or C seamless steel pipe of the following classes (According to ANSI B-36-10) is recommended:

Pipe Size	**High-pressure System**	
	Max Working Pressure	**Pipe class**
3/4″	140 bar	Sch 40 or larger
1″		Sch 80 or larger
1 1/4″		
1 1/2″		
2″		
2 1/2″		
3″		
4″		

- Fittings shall be according ANSI/ASA 3000 and shall be rated at least to 3000 lbs/in^2.
- Connection by means of welded or threaded accessories:
- Welding for pipes smaller or equal to 2" nominal diameter should not be performed in situ. The connections performed in situ should be threaded.
- The installation must be earthed.
- The colour of pipe paint should be red (RAL. 3000).

5.4.2 Supports.

- Every installation should have a minimum of two supports that hold the pipe system.
- The maximum distance between the two supports along pipe should never exceed the following values:

Nominal Diameter (mm)	Nominal Diameter (inches)	Maximum Distance among supports (m)
10	3/8”	1,0
15	1/2”	1,5
10	3/4”	1,8
10	1”	2,1
40	1 1/4”	2,4
40	1 1/2”	2,7
50	2”	3,4
65	2 1/2”	3,5
80	3”	3,7
100	4”	4,3

- Whenever pipe is more than 2 inches (DN 50) and table distances cannot be adhered to because of building designs, these distances may be raised to 6m between supports, as long as they are double.
- The pipe supports should be located next to the pipe joints, to elbows and to changes in pipe direction.
- The supports should connect the pipe system directly to the building structure and should not be used to support other objects. The parts of the building where supports are fixed should be strong enough to take the load (see table for design load). Otherwise, additional straps should be fixed to other resistant parts. Only pipes with nominal diameters less than or equal to 50 mm may be attached to the metallic structures in the form of trusses or concrete slabs (the design should be approved by the authorities). The concrete fastening plugs should be located at least 150 mm away from the edge of the slab.
- The distance between the nozzle and its support should be the shortest possible:
  - For pipes with a smaller or equal diameter to 25 mm, the maximum distance from support to nozzle should be 0’1 m.
  - For pipes more than 25 mm diameter, the maximum distance from support to nozzle should be 0’25 m.
- Support type hangers or manifold "U" fixings are recommended. Pipe brackets and other fittings for holding pipes, should completely surround the pipe and be closed.

☛ Supports should comply with the following minimum requirements for sectional areas and depth anchoring:

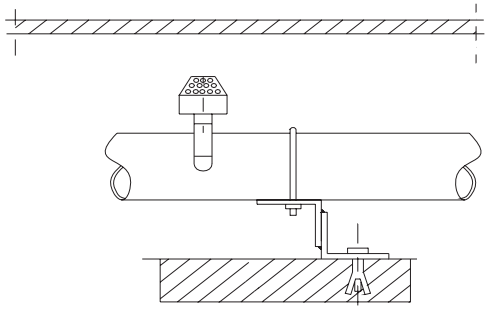
Pipe nominal diameter	Design load (N)	Minimum support section (mm)	Thread size (metric)	Minimum depth of anchor for concrete fastening plugs (mm)
Up to DN 50 (2″)	2000	30	8	30
Between DN 50 (2″) & DN 100 (4″)	3500	50	10	40
Between DN 100 (4″) & DN 150 (6″)	5000	70	12	40
Between DN 150 (6″) & DN 200 (8″)	8500	125	16	50
Between DN 200 (8″) & DN 250 (10″)	10000	150	20	60

- The minimum cross-sectional area of the supports should be no less than 30 mm^2.
- The support material should be at least 3 mm thick. If galvanised, 2’5 mm thickness will be enough. In the case of heat galvanised supports, the minimum dimensions should be 25 mm x 1.5 mm for pipes up to 50 mm (2") nominal diameter and 12 mm x 1’5 mm for approved models.

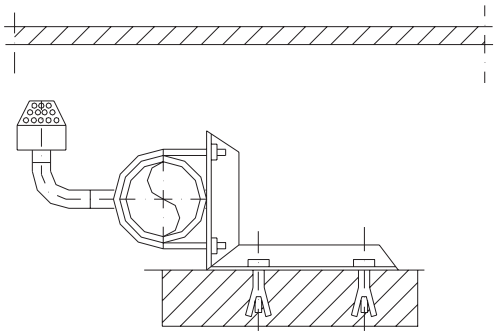
The following types of support are included as examples:

FIXED SUPPORT HORIZONTAL WALL

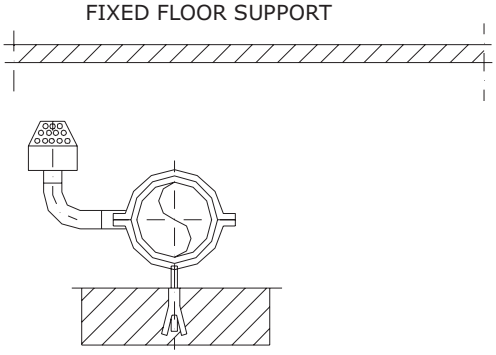
Z FALSE FLOOR SUPPORT

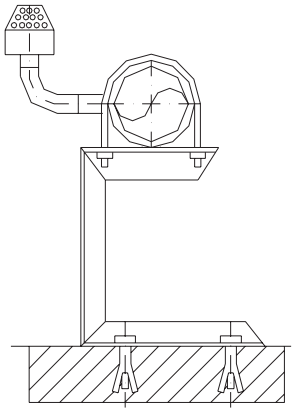


FIXED FALSE FLOOR SUPPORT

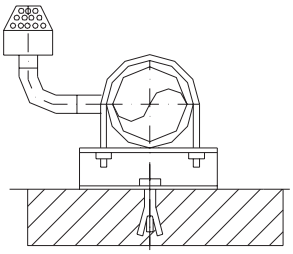


FIXED FLOOR SUPPORT

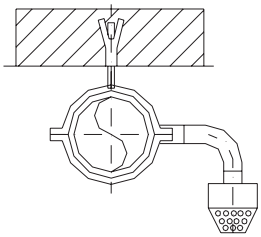




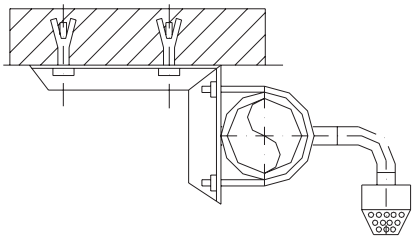
FIXED FLOOR SUPPORT



SUSPENDED CEILING SUPPORT



FIXED SUSPENDED CEILING SUPPORT



5.4.3 Nozzles.

Description:

The nozzles are the devices through which the gas is discharged within the protected enclosure. It consist of an internal core (1) with 4 discharge orifices and a central one which can be calibrated according to the hydraulic calculations and an external metallic cone (2) to drive the discharge flow.

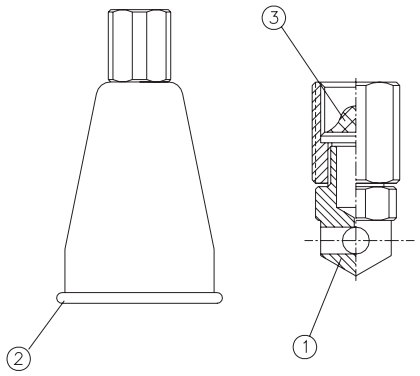
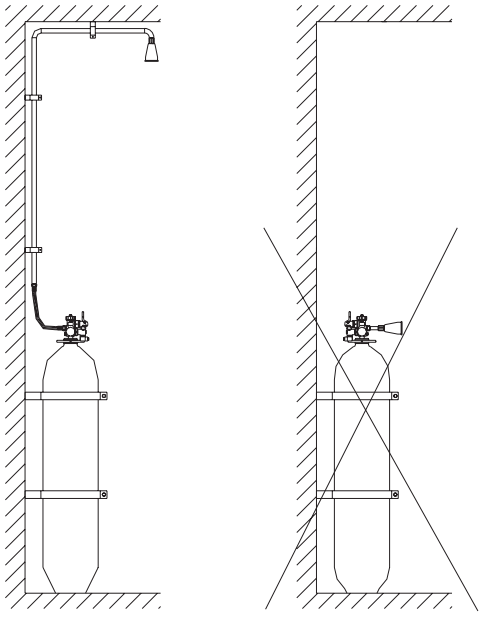


Fig. 5.4.3.1. *Nozzle.*

The calibration of the orifice shall not be less than 1 mm. Nozzles shall be provided with an internal filter capable of preventing obstruction of the calibrated orifice when its diameter is 3 mm or less. For larger diameters the nozzle shall not be provided with the filter.

Installation:

The nozzle is designed to be installed directly over the pipe. Apply thread sealing compound or Teflon tape to the distribution pipe thread and tight using the right fixed wrench.



OK	FORBBIDEN

To prevent mistakes during installation, every nozzle should incorporate legible and long lasting inscriptions indicating the calibration diameter, and the identification of its location in the drawing with reference to the Project and the system hydraulic calculation. As standard LPG carry out mechanic engraving (punched) on the nozzle bodies with the above mentioned inscriptions.

NOTE:	***Fixing of the nozzles and nozzle alignment is very important. the nozzles should never point at false ceilings or mobile parts as gas discharge could raise the ceiling tiles or drag objects. never locate discharge nozzles directly on the valve outlet.***

5.5 ELECTRICAL INSTALLATION.

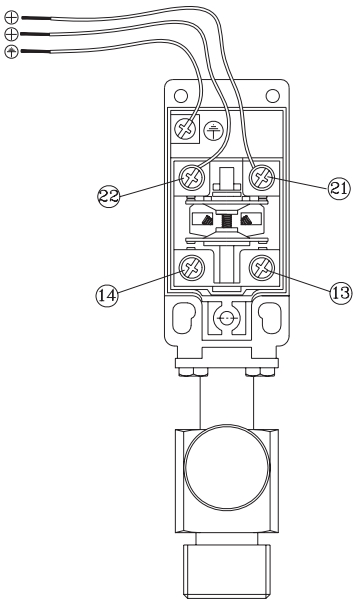
EVERY FIRE FIGHTING INSTALLATION SHOULD BE CONNECTED TO GROUND

After carrying out the pneumatic Installation installation and **with the pilot valve head caps dismantled,** carry out the electrical connection of the components that require so. When these components are fed through to a control panel, it is recommended to read the installation instructions carefully for the main control so as to prevent accidental electrical device effect that may, in some cases, cause complete discharge of the whole cylinder bank.

NOTE: ***LPG electrical components do not have polarity. all electrical connections should be undertaken in such a way that the cables reach right to the device to prevent cable confusion later for starting up and maintenance operations.***

☛ **Electrical connection of the pressure switch with locking device:**

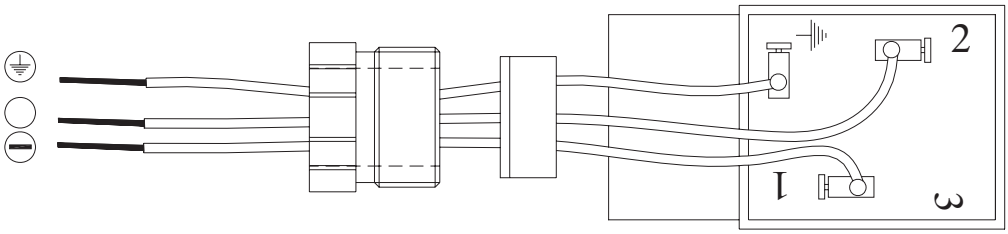
For a normally closed circuit connect to terminals 21 and 22. For a normally open circuit connect to terminals 13 and 14.



NOTE: ***The voltage supply should only be done at the moment of detecting a fire, as it will produce cylinder discharge. ensure that the solenoid supply is shut off during electrical connection.***

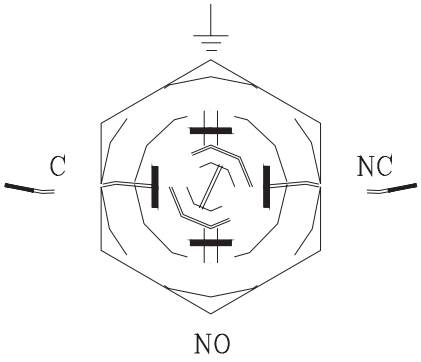
☛ Electrical connection of the solenoid valve:

Nominal voltage : 24 VDC
Cold consumption: 13 W
Hot consumption: 10 W
Connect to earth.



NOTE:	***Once all installation Installation is finished install all cylinder bank valve head caps***

☛ Pressure switch electrical connection:



5.6 INSTALLATION FINAL REQUIREMENTS.

- All the cylinders, including pilot cylinders, should have an adhesive label attached indicating their identification number (coinciding with the one engraved on its shoulder) gross weight, net weight and date of fill.
- The paint of all components should be in perfect condition. Repaint those areas where the paint has been damaged. In case of any oxide, prepare the surface; apply a coat of metal primer and finish by applying a top coat of paint. The colours for *carbon dioxide (CO_2)* fire extinguishing systems are: RAL 9011 black for the cylinder body, RAL 7023 grey for the shoulder and RAL 3000 red for the pipe system.
- Each cylinder bank should be identified by means of a notice indicating:
  - Hazard protected
  - Warnings
  - Instructions for use and manual operation
- The notices should be firmly affixed and visible to the parts fitted and must be resistant to climatic and environmental conditions to which they may be exposed (dust, dirt, etc.).
- The pressure gauge of the pilot cylinder should indicate an accurate pressure reading.
- The CUT-OFF valve has to be in the right working position.
- No fault or alarm system has to be present in the control panel.